BRITISH BATTLESHIP VS GERMAN BATTLESHIP

1941–43

ANGUS KONSTAM

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INTRODUCTION

To some eyes, there were only two real clashes between British and German battleships in this period, and the first of these also involved a British battlecruiser – the unfortunate *Hood*. The second fight, three days later, was a one-sided affair, pitting the now crippled *Bismarck* against two battleships of the British Home Fleet. If, though, we include the class of German battleships which the British inaccurately described as 'battlecruisers', then the scope can be widened. The two powerful capital ships of the Scharnhorst class were fully fledged battleships, albeit ones that carried a

The launch of the KMS *Bismarck* into the Elbe River, on 14 February 1939. She remained in Hamburg for her fitting out, and entered service a year and a half later. During her construction, the Kriegsmarine did what it could to conceal her true size and fighting potential from other naval powers.

lighter calibre of gun than their British counterparts. These two battleships took part in several clashes and potential encounters between May 1941 and December 1943. These included two largely forgotten clashes between them and lone British battleships, and a decisive one between *Scharnhorst* and the British battleship *Duke of York*.

If the net is cast wider still, we can also consider a number of occasions where a surface action between British and German capital ships was narrowly avoided. For instance, on two occasions in 1943, *Bismarck*'s sister ship the *Tirpitz* sortied from Norway to attack the Arctic convoys. On both occasions, a surface clash never took place, but if the circumstances had been even slightly different, it would have resulted in one of the most important naval actions of the war. Taken as a whole, what is striking about these encounters is the way they demonstrate both the immense firepower of the battleship during this period, and the changing ways in which this latent power was directed. They also show that these titanic duels were becoming increasingly uncommon. During the war, technology changed the way surface actions were fought, with a greater emphasis being placed on the use of radar fire control systems, and on using radar to guide a force of warships into action against the enemy.

The Nelson-class battleship *Rodney* may have been ugly, with her towering superstructure and her turrets bunched in front of it, but she packed an impressive punch. Although outclassed by the more modern generation of battleships, she and *Nelson* still formed the powerful core of Britain's wartime battle fleet.

The prime example of this new technology in action is the Battle of North Cape, fought in late 1943 in the darkness of the Arctic winter, and amid blinding snowstorms. The destruction of the *Scharnhorst* was brought about by the use of radar to locate and track the German battleship, and then to engage it in conditions that rendered more traditional methods of gunnery almost impossibly challenging. Clearly, this demonstrated the rapid development of naval gunnery during the few years since *Scharnhorst*'s earlier encounters in the spring of 1941. Another development was the increasing importance of naval aircraft, both for reconnaissance and strike missions. The presence of aircraft led to a curtailment of one clash with a British battleship in March 1941, during Operation *Berlin*, and a few months later, an air-launched torpedo crippled *Bismarck*, allowing the battleships of the British Home Fleet to intercept her the following morning. Like radar, airpower was changing the face of naval warfare.

This said, in all of these encounters, the final arbiter of victory or defeat was the big gun. The rapid development of naval ordnance during the first decades of the 20th century meant that by the end of World War I, the battleship gun had almost reached the pinnacle of its evolution. Certainly, there was scope for further developments, such as the introduction of even larger pieces of naval ordnance – guns like the 16in. pieces

carried in Britain's Nelson class. Further technological improvements were made in the design of the projectiles these guns fired, and in the mounting of guns in turrets with three or even four barrels. The interwar years also saw improvements in the elevation and so potential range permitted by gun mountings. In spite of this, the technical business of gunnery had remained largely unchanged since the great clash at Jutland in 1916. Even improvements in fire control and gunnery direction were incremental rather than revolutionary. This, though, was about to change.

By the 1940s, the development of more-integrated gunnery direction systems permitted a far more accurate targeting of an enemy ship using visual rangefinding, fire control radar or a combination of the two. Additionally, the more sophisticated fire control systems carried on board battleships such as the Bismarck and King George V classes relied on highly complex plotting systems to target the enemy and ensure the battleship's salvos were directed as accurately as possible. This, in turn, permitted the use of radar guidance, at least after the development of reliable fire control radar. Until then, British and German battleships relied on slightly different gunnery direction systems, but arguably, they were so similar as to be virtually identical in terms of accuracy and effectiveness. This development, then, as well as the resulting use of command control centres, provided all of the elements needed to raise naval gunnery to a new and more sophisticated level.

By 1943, though, the age of the 'big gun' was all but over. It was now clear that the future of naval warfare lay in naval aviation, in the use of ever more potent submarines and in new weapons such as glide bombs – the forerunner of the guided missile. Increasingly, a naval battlegroup of the kind used by the Kriegsmarine in northern Norway, or the British Home Fleet in Arctic waters, would not consider putting to sea without a protective umbrella of aircraft and a scouting screen of U-boats or submarines. The British increasingly built their task groups around aircraft carriers, rather than battleships. This all helped to make a surface clash between British and German battleships increasingly unlikely. The Battle of North Cape bucked this trend. It also brought an end to the Kriegsmarine's offensive use of its remaining capital ships. After the loss of the *Scharnhorst*, these powerful ships had simply become too expensive to operate, and too prestigious to lose.

CHRONOLOGY

1939

7 January *Scharnhorst* enters service.

21 February *King George V* launched at Armstrong Whitworth shipyard, on the River Tyne.

14 February *Bismarck* launched at Blohm & Voss shipyard, Hamburg.

1 April *Tirpitz* launched at the Kriegsmarinewerft, Wilhelmshaven.

3 May *Prince of Wales* launched at Cammell Laird shipyard, Birkenhead.

3 September Britain and France at war with Germany.

23–30 November Attempted Atlantic sortie by *Gneisenau* and *Scharnhorst*.

1940

24 February *Anson* launched at Swan & Hunter shipyard, Wallsend.

28 February *Duke of York* launched at John Brown & Company shipyard, Clydebank.

9 April Operation *Weserübung* begins – the German assault on Denmark and Norway.

9 April *Howe* is launched at the Fairfield Shipbuilding and Engineering Company, Govan – the last of the five British King George V-class battleships.

Scharnhorst and *Gneisenau* engage the battlecruiser *Renown*.

8 June *Scharnhorst* and *Gneisenau* sink the carrier *Glorious*.

July *Scharnhorst* and *Gneisenau* undergo repairs in Kiel.

24 August *Bismarck* enters service and commences sea trials.

2 December *King George V* enters service with the Home Fleet.

28 December *Scharnhorst* and *Gneisenau* return to active service.

1941

22 January Operation *Berlin* commences – Atlantic sortie by *Scharnhorst* and *Gneisenau*.

25 February *Tirpitz* enters service, and commences sea trials.

22 March Operation *Berlin* ends, as *Scharnhorst* and *Gneisenau* reach Brest.

31 March *Prince of Wales* enters service.

April *Gneisenau* damaged during air attacks on Brest.

19 May Operation *Rheinübung* begins – sortie by Bismarck and heavy cruiser *Prinz Eugen* into the North Atlantic.

24 May Battle of the Denmark Strait – *Hood* sunk, *Prince of Wales* damaged.

27 May *Bismarck* sunk in action with *King George V* and *Rodney*.

24 July *Scharnhorst* badly damaged by air attack.

October *Prince of Wales* ordered to Singapore.

4 November *Duke of York* enters service.

7 December Japanese attack on Pearl Harbor – Britain at war with Japan.

10 December *Prince of Wales* and *Renown* sunk off Malaya.

1942

January *Tirpitz* deployed to Norway.

11–13 February The Channel Dash – *Scharnhorst* and *Gneisenau* are damaged, but reach Kiel.

24 February *Gneisenau* badly damaged by air attack, and subsequently decommissioned.

6–9 March *Tirpitz* sorties in an attempt to intercept Arctic convoy PQ 12.

June *Scharnhorst* repaired and sent to the Baltic for trials.

22 June *Anson* enters service.

5–8 July *Tirpitz* sorties in an attempt to intercept Arctic convoy PQ 13.

29 August *Howe* enters service.

1943

January *Scharnhorst* deployed to Norway.

8 May *Duke of York* becomes new flagship of Home Fleet.

22 September Operation *Source* – *Tirpitz* is badly damaged by Royal Navy midget submarines.

26 December Battle of North Cape – *Scharnhorst* is sunk by *Duke of York*.

1944

3 April *Tirpitz* damaged in a naval air attack in the Altenfjord.

June *Nelson* and *Rodney* participate in Operation *Overlord* – the Allied invasion of Normandy.

November *Rodney* is relegated to duties as a static port flagship in Scapa Flow.

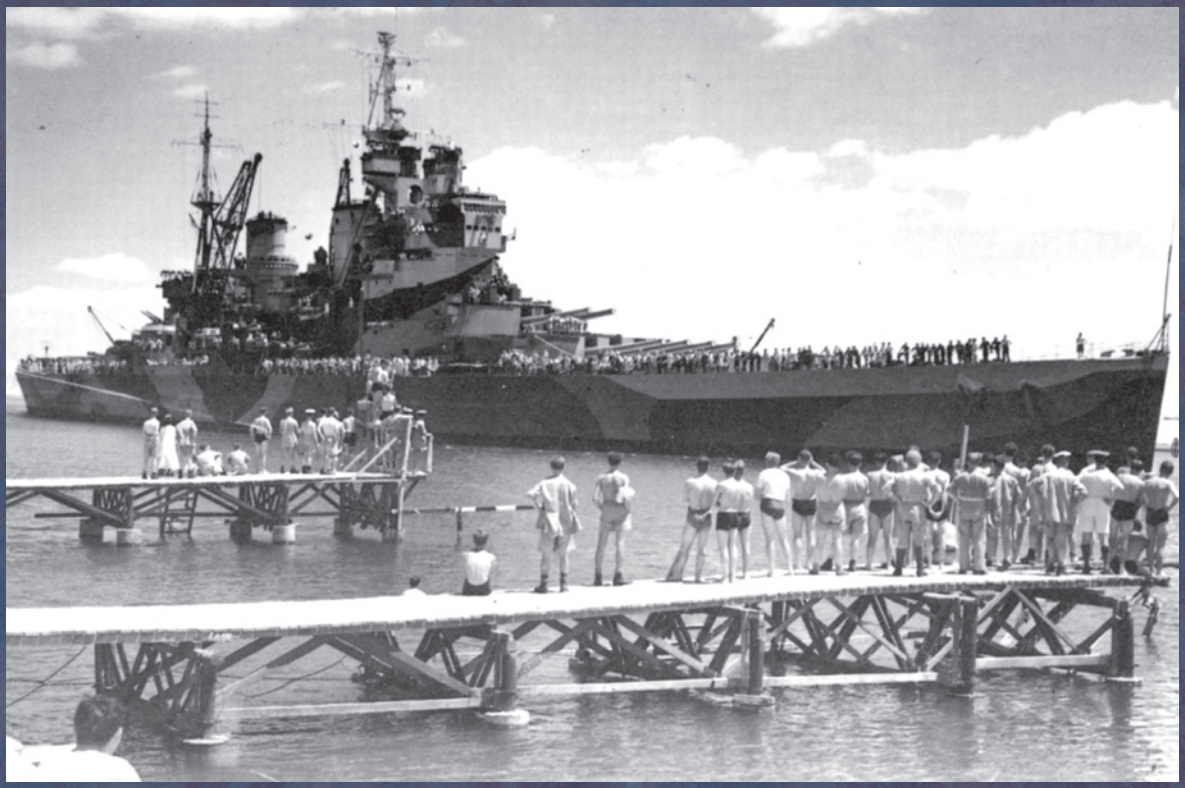
12 November *Tirpitz* is sunk by the RAF off Tromsø.

1945

28 March *Gneisenau* scuttled in Gotenhafen (Gdynia).

8 May Victory in Europe (VE) Day – end of the war with Germany.

2 September Victory over Japan (VJ) Day – end of war in the Pacific.



HMS *Howe*, pictured as she passes through the Suez Canal in July 1944, on her way to join the British Eastern Fleet. Her complement of light anti-aircraft weaponry was increased before she left for the Far East, and she was fitted with an impressive radar array.

DESIGN AND DEVELOPMENT

NAVAL DEVELOPMENTS, 1919–43

The notion of the big-gun battleship came into vogue at the start of the 20th century, and resulted in the creation of the 'dreadnought'. HMS *Dreadnought*, launched in 1906, carried a main armament of ten 12in. guns, mounted in five twin turrets. Until then, a typical 'pre-dreadnought' battleship was armed with just four big guns.

The KMS *Scharnhorst*, pictured at anchor off Kiel shortly before the outbreak of war. Her sister ship *Gneisenau* is lying off her starboard bow, while a Deutschland-class armoured cruiser can be seen off her starboard beam. A catapult for an Arado float plane can be seen on top of her after (Caesar) turret.

Together with her modern steam turbine propulsion and powerful protection, *Dreadnought* was in a class of her own, and transformed the nature of naval warfare. The age of the dreadnought had arrived.

Before and during World War I, the major maritime powers built their own dreadnoughts. By the outbreak of war in 1914, Britain and Germany had each built a whole battle fleet of them. In most cases, each new class of ships contained improvements on its predecessors, with better guns and more protection. These mighty rivals – the British Grand Fleet and the German High Seas Fleet – would dominate the course of the naval war. When the decisive clash came at the Battle of Jutland (31 May 1916), the German fleet was outmanoeuvred and forced to withdraw. Although the clash was indecisive, and the British actually lost more warships, the battle proved a strategic victory for the Grand Fleet. After Jutland, the High Seas Fleet rarely put to sea, and when it did, it avoided another high-stakes encounter.

The coming of peace in November 1918 saw the High Seas Fleet interned in Scapa Flow, where its crews would scuttle their ships the following summer. For the British, peace brought disarmament, and for the most part, the dreadnoughts were sent to the breakers yard. Peace was followed by diplomatic negotiation, as the major Allied powers tried to cut their naval budgets by scaling down the size of their battle fleets. This led directly to the Washington Naval Treaty (1920), through which Britain, France, Italy, Japan and the United States agreed to limit the size of their battleship fleets in relation to each other. As a result, the Royal Navy's battle fleet was scaled down, until virtually all that remained were her ten 'fast battleships' armed with 15in. guns. Other navies scaled back their fleets, too, but they were all aware that they also needed to build new battleships if they wanted to maintain their place in the world's naval hierarchy.

It was inevitable that any new battleships would incorporate the lessons learned during the war, as well as the wartime developments in naval design. However, their design would also be constrained by the terms of the Washington Naval Treaty, which placed a limit on both displacement and the maximum gun calibre of new battleships.

KMS *Tirpitz*, pictured in the Fættenfjord near Trondheim, Norway. She spent most of her wartime career in Norwegian waters. Although she rarely sortied from there against the Arctic convoys, she remained a latent threat to the Allies, forcing the Home Fleet to maintain a powerful battleship force in the Arctic.

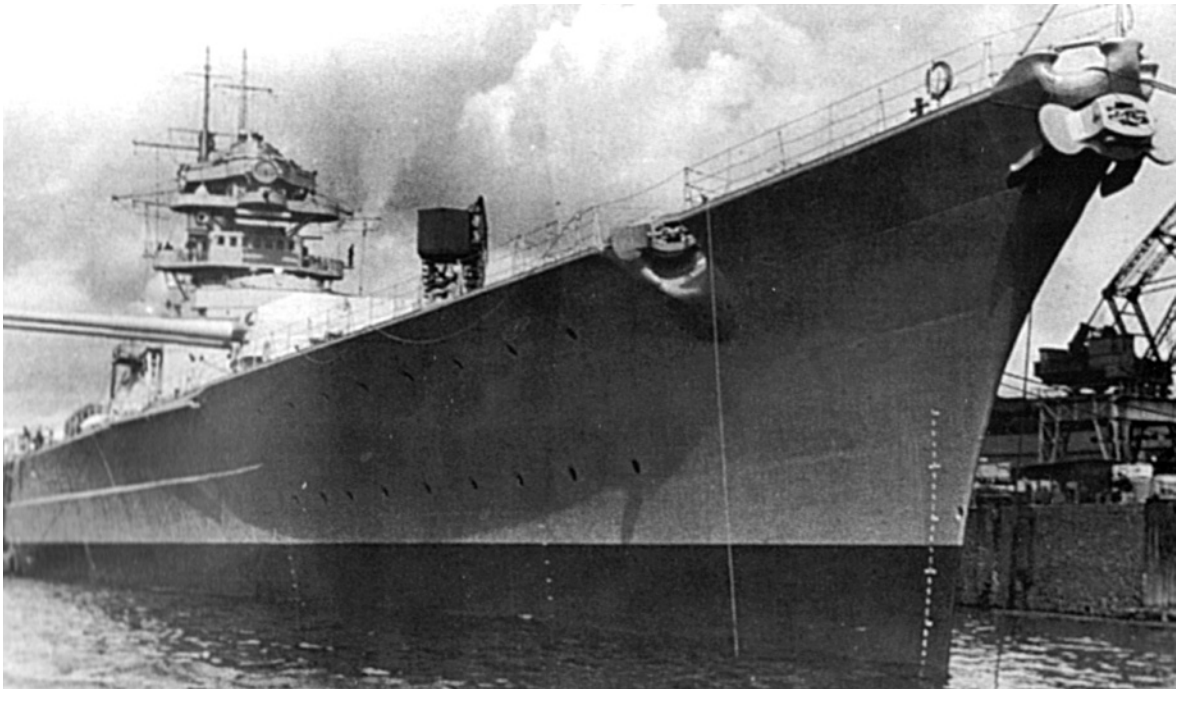
In terms of wartime design, much had been learned about adequately balancing the three cornerstones of warship design: firepower, speed and protection. This was combined with lessons learned – particularly from the Battle of Jutland – regarding key areas such as ammunition handling, the safety of propellants and minimizing the risk of flash fires. Similarly, wartime experience provided valuable lessons in the defence of capital ships against torpedoes, and in limiting the threat posed by mines through improved watertight integrity within the ship.

These lessons and developments were integrated into new battleship designs during the interwar years, but the other influence was the terms of the Washington Naval Treaty itself. By imposing a displacement limit on battleships, and an upper limit on gun calibre, naval architects were forced to compromise. The trinity of firepower, speed and protection needed to be treated carefully, as any emphasis of one factor over the others meant a reduction in their quality. This led to efforts to reduce overall weight, in order to pack the most into a design. Also, in some cases, it led to the disguising of a new warship's true displacement, to avoid it breaching the terms of the treaty. One result was further diplomatic talks, which in turn led to the London Naval Treaty (1930), and the Anglo-German Naval Agreement (1935), where Germany's naval needs were considered for the first time.

In the Washington Treaty, the expected life of a battleship was considered to be 20 years. So, warships that had entered service during World War I were expected to be replaced during the mid-1930s. The treaty also guaranteed the naval superiority of Britain and the United States, and while the other smaller naval powers might have wished to increase the size of their battle fleets, the onset of a worldwide economic depression meant that the money for large-scale naval construction simply was not available. The London treaty resulted in a further five-year halt to new construction, pushing things to the very limit of the life of battleships built during the previous war. While Britain and the other powers modernized their existing battleships, new construction still was not on the agenda.

This said, during the 1920s, Britain built two new battleships, as part of a commitment built into the Washington treaty. These Nelson-class vessels were designed to comply with treaty restrictions on displacement and armament, as were similar new battleships being built by both Japan and the United States. However, they also demonstrated how these same limitations were encouraging naval architects to come up with novel solutions, in order to make the most out of these new designs. In the case of *Nelson* and *Rodney*, this led to the use of triple turrets, and the 16in. gun. These battleships were criticized for their ungainly appearance and their unusual turret configuration, but this merely reflected the way the designers got around the treaty restrictions by getting the most out of every ton of weight. This was necessary because other nations – most notably the United States and Japan – were doing the same.

The triple turrets on these new Nelson-class battleships were plagued by technical problems, which took several years to iron out. The same was true of the even more innovative quadruple turrets in the battleships of the King George V class. This could not be said of the vessels of the German Scharnhorst class, which were designed during the 1930s. Their triple turrets worked well, thanks to a certain degree of over-engineering in terms of technical performance. This, though, was largely because these turrets had already been designed and installed in the Deutschland-class *Panzerschiffe*,



With her clean, modern lines, KMS *Bismarck* was a sleek and graceful ship, but she was also a deadly one. This photograph was taken while she was still being fitted out in the Blohm & Voss yard in Hamburg.

and so most technical challenges had been overcome. The adoption of a slightly improved version of the 28cm (11in.) guns mounted in the *Panzerschiffe* helped speed the completion of the new battleships, despite last-minute concerns about the relatively small calibre of this ordnance. Instead, German designers worked on improving the gun's velocity, and therefore the penetrating power of its shells.

Improved penetration was something of a holy grail of ordnance designers. As a rule of thumb, during the interwar years the calibre of a gun was roughly equal to the thickness of belt armour its shell could penetrate. German designers sought to improve this ratio by increasing the velocity of a shell through the lengthening of the gun's barrel. However, the same increase could also be achieved by increasing the calibre of the weapon. Ultimately, this is what British designers did during the 1920s with the adoption of the 16in. gun, and what German ones did a decade and a half later when the 38cm (15in.) gun was mounted in the battleships of the Bismarck class. When the British adopted the 14in. gun for the battleships of the King George V class, this was something of a retrograde step, albeit one forced upon designers by the terms of the naval treaties. The result was a lower-velocity weapon, which made these battleships relatively weak in terms of their firepower.

During the interwar years, designers also recognized the need to improve a battleship's secondary batteries. This was due to the increasing threat posed by fast, torpedo-armed destroyers and by aircraft. Here, Britain and Germany adopted different approaches. The Kriegsmarine opted for two different calibres of secondary guns: one to engage fast surface ships, and another smaller-calibre, high-angle one to fire at aircraft. In theory, the British preferred a single calibre of secondary battery with a high-angle capability, so it could engage both types of target. However, the 6in. guns of the Nelson class had too slow a rate of fire to serve as anti-aircraft weapons, and so

lighter 4.7in. QF (quick-firing) guns were carried as well. The King George V class carried the 5.25in. QF gun, which was a true DP (dual-purpose) gun, although it, too, had its limitations in terms of rate of fire and its ability to track high-flying aircraft.

This ordnance was of little use if the gunners could not hit their target. That required accurate ranging, to determine the range and bearing to the target, and spotting, which involved the correction of the fall of shot. On all battleships of this period, this information was supplied by an array of rangefinders and optical instruments. This basic gunnery direction system had been in place during World War I, and while it had been perfected, the main components were essentially the same, at least in terms of engaging surface targets. The growing need for a powerful anti-aircraft capability led to the development of tracking systems capable of targeting a warship's fire against aircraft. The British High Angle Control System (HACS) developed during the 1930s was flawed, as it was incapable of accurately targeting fast-moving modern aircraft.

The German SL (Stabilisierter Leitstand) anti-aircraft fire control system was much more effective, but ironically, it had problems directing fire against slow-moving, low-flying aircraft, such as the Fairey Swordfish. The threat posed by aircraft had increased dramatically during the 1930s, as a new generation of fast torpedo- and dive-bombers entered service. This led to an increase in the number of lighter anti-aircraft guns fitted to existing battleships, as well as newly constructed ones. In general terms, their numbers continued to increase as the war progressed. The Royal Navy and the Kriegsmarine had their own light anti-aircraft weapons, including the British 2-pdr pom-pom and the German 3.7cm mounts, which were capable of being integrated into the anti-aircraft fire control system used by the ship. Augmenting this, though, were an increasing number of lighter 20mm guns. These often replaced machine guns, which lacked the hitting power of these larger-calibre automatic weapons.

This threat posted by aircraft also led to the development of early radio direction finding (RDF) systems – later known as radar – and the installation of radar equipment on board battleships. In the mid-1930s, several major powers experimented with RDF, but it was the British who first produced a working RDF system. In naval terms, this developed into three main categories: air warning, surface search and fire control. The first sets were extremely primitive, with very limited ranges, and were often unreliable. However, the range, reliability and performance of naval radar improved dramatically, and by 1943, it formed a vital new component in a battleship's fighting potential. This was particularly true for the British, who not only installed workable radar sets into their battleships before the Germans, but went on to develop a significant technological and qualitative lead over their opponents as the war progressed.

BRITISH BATTLESHIPS

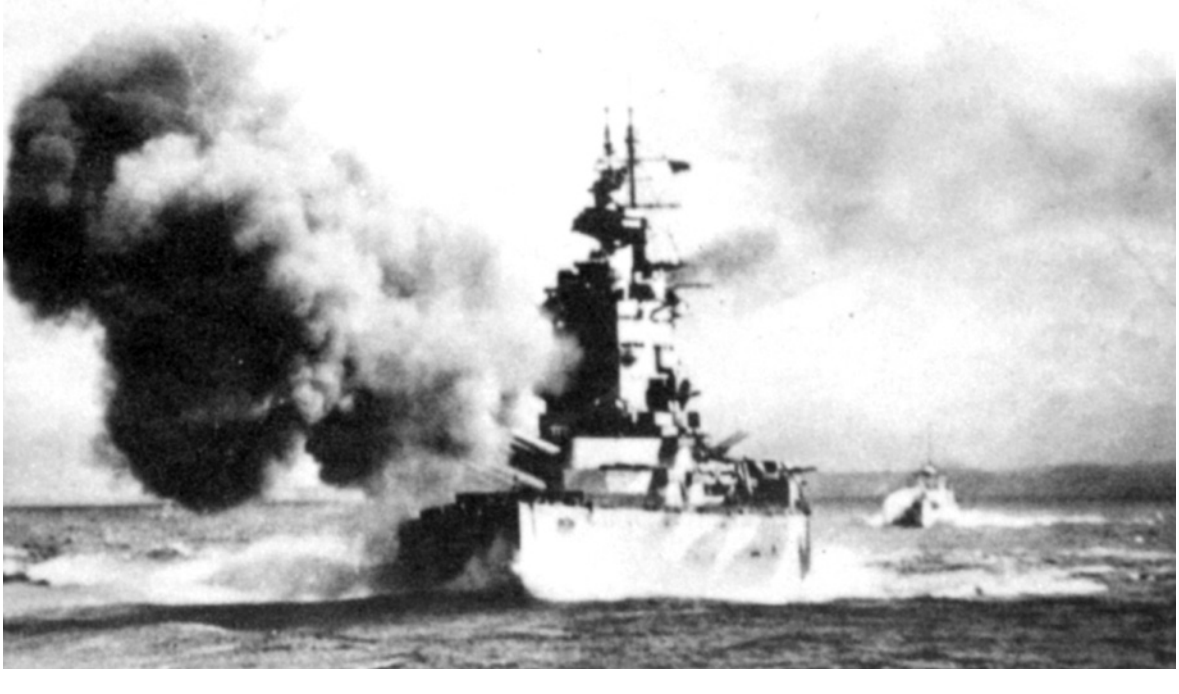
Following the Washington Naval Treaty of 1920, the Royal Navy disposed of most of its large fleet of dreadnoughts. Only the most modern 'fast battleships' in the fleet were spared the axe. These were faster than the earlier classes of dreadnoughts, and they burned oil rather than coal. More importantly, they were better protected, with armoured

belts up to 13in. thick, and they were all armed with 15in. guns, in four twin turrets. The five battleships of the Queen Elizabeth class (*Queen Elizabeth*, *Warspite*, *Barham*, *Valiant* and *Malaya*) were retained, as were the five of the Royal Sovereign class (*Royal Sovereign*, *Revenge*, *Royal Oak*, *Resolution* and *Ramillies*). The Queen Elizabeths were all modernized to some extent during the interwar years, but very little was done to the Royal Sovereigns, apart from improving their anti-aircraft defences. All ten of these ageing World War I-era battleships were still in service in September 1939.

NELSON CLASS

Under the terms of the Washington treaty, the displacement of newly built battleships was capped at 35,000 tons, while the maximum calibre of their guns was 16in. As the British Admiralty planned to build two new battleships, these became the main design parameters. This also gave naval designers the chance to incorporate the lessons learned during the war. What the Director of Naval Construction (DNC) produced was a cut-down version of the plans already developed for the cancelled G3 battlecruiser. In order to comply with the treaty limits, these new battleships were slower and less well protected than the G3 design, but they also carried nine 16in. guns, the largest battleship guns permitted by the treaty. Displacement was also reduced by using high-tensile steel, and by careful weight management during construction. In naval circles, these ships became known as the 'Cherry Tree class', because they were 'cut down by Washington'.

The result, though, was two thoroughly modern Nelson-class battleships. Their powerful armament also meant that *Nelson* and *Rodney* were the most powerful battleships afloat – a mantle they held until 1940, when a new generation of battleships began to appear. The most marked feature of these ships was their ungainly appearance,



HMS *Nelson* in July 1943, firing a full salvo of nine 16in. shells during the Allied invasion of Sicily. Her guns are at their maximum elevation, so presumably she is firing at Axis targets located far inland. At this elevation, her main guns had a range of over 20 miles.

as all three of their turrets were mounted forward of the bridge. This was the result of the 'all or nothing system' of protection, where the thick armoured belt was concentrated around the guns and magazines, the machinery spaces and the conning tower. These battleships were also given a well-armoured protective deck to protect these vital areas. Elsewhere, the ship was given minimal protection – proof against splinter damage, and little else. This was a weight-saving measure, but it allowed the designers to provide these ships with an armoured belt worthy of a modern battleship, while staying within the limits of the treaty.

This was not the only innovation. In fact, the ships of the Nelson class set a new bar for battleship design during the interwar years. The armoured belt lay inside the outer hull, and was angled at 72°, to improve its protective capabilities. This, together with the water-filled torpedo protection system built into the lower hull, was based on wartime lessons, and represented an advance on all previous designs. Another innovation was the block-like forward superstructure, which offered better protection to the gun directors, conning tower and bridge, and provided good visibility for the gunnery direction teams. One drawback, though, was the lack of protection given to the secondary armament of these battleships.

Nelson and *Rodney* were powerful ships for their time, but during the war, they were outclassed by a new generation of battleships, largely on account of their comparative lack of speed, and the way newer battleships incorporated developments in technology more readily than these interwar battlewagons. Their main armament proved problematic, too. The first problem was its configuration, with half the hull length devoted to the guns. 'A' and 'B' turrets could fire forward, but 'X' turret behind them could not, and so had a relatively limited arc of fire. While the 16in. guns they carried were extremely powerful weapons, they and their triple turret mountings were innovative, and thus suffered from technical teething problems. While these had largely been overcome by 1939, they still had a relatively slow rate of fire due to an excessive regime of safety measures. Powerful though they were, these two battleships never fully realized their immense fighting potential.

Nelson class	
Two ships in class: *Nelson*, *Rodney*	
Displacement:	*Nelson*: 33,313 tons, *Rodney*: 33,730 tons (standard)
Length:	710ft overall (216.4m); Beam: 106ft (32.31m); Draught: 28ft 1in. (8.56m)
Propulsion:	Two shafts; two Brown-Curtis geared turbines; eight Admiralty drum boilers, generating 45,000shp
Maximum speed:	23kts
Protection:	Belt: 13–14in.; Deck: 6.75in.; Main turrets: 7.25–16in.; Secondary turrets, torpedo bulkheads: 12–15in.; Conning tower: 6.5–14in.
Armament:	Nine 16in. Mark I guns, in three triple turrets; 12 6in. Mark XXII guns in six twin turrets; six 4.7in. Mark VIII High Angle (AA) guns in single mounts; two 24.5in. torpedo tubes in submerged mounts
Aircraft:	None
Complement:	1,314 men (1,316 when serving as flagship)

Construction and key dates					
Ship	**Builder**	**Laid down**	**Launched**	**Commissioned**	**Fate**
Nelson	Armstrong Whitworth	28 December 1922	3 September 1925	August 1927	Broken up 1948
Rodney	Cammell Laird	28 December 1922	17 December 1925	November 1927	Broken up 1948

ABOVE
The interior of the gun turret of a Nelson-class battleship. Here, the crew are performing routine maintenance checks. In action, the gun crews would wear anti-flash hoods and gloves. Due to the weight of her shells and charges, the loading and firing of these 16in. guns was heavily automated.

KING GEORGE V CLASS

The Washington treaty included a ten-year moratorium on the building of new battleships – *Nelson* and *Rodney* excepted. This was later extended by another five years. By the mid-1930s, with this moratorium due to expire, the DNC began developing plans for a new generation of battleships, albeit still within the displacement ceiling of 35,000 tons. These would be the first new battleships to enter service with the Royal Navy for more than a decade. The Second London Naval Treaty (signed on 25 March 1936) set a maximum gun calibre of 14in., and so the DNC considered a number of different permutations of ordnance and configuration, while still staying within the treaty's displacement limits. This included carrying four twin turrets, three triples and every main gun calibre from 12in. to 16in. In the end, the designers opted for the treaty maximum of both displacement and gun size.

The final design called for an innovative configuration of ten 14in. guns, with 'A' forward and 'X' turret aft being quadruple mounts, while 'B' turret

HMS *KING GEORGE V*

Although her design was influenced by the constraints of the London Naval Treaty, *King George V* and her four sister ships were still powerful battleships. While their unusual gun calibre and turret configuration has been criticized, her guns and mounts performed well once the initial teething troubles had been overcome. During 1941, *King George V* served as the flagship of the Home Fleet, and while flying the flag of Admiral Tovey, she participated in the final destruction of the *Bismarck*.

(superimposed behind 'A') was a more conventional twin turret. A relatively powerful armoured belt was provided, which was considerably more extensive than in the Nelson class, and the propulsion system was also improved. The secondary battery would consist of 5.25in. dual-purpose guns, in twin turrets. All things considered, this was a good design, albeit one forced on the DNC by the treaty limits. In practice, not only were these 14in. guns slightly less powerful than the guns carried on most other modern battleships, but both the guns and their mountings were plagued by technical problems. This was mainly due to the anti-flash safety systems incorporated into the turret designs, and it took until 1942 before these teething problems were finally overcome. These battleships were also slightly slower than their new German counterparts, but mechanically they were extremely sound – much more so than their ageing forebears of the Nelson class.

Like the Germans, Americans and Japanese, Britain also dreamed of big post-treaty battleships. Plans were produced for a Lion class of battleship, displacing over 40,000 tons, and armed with 16in. guns. Effectively, though, the design and building of this new generation of British battleships were overtaken by the coming of war. Although *Lion* and *Temeraire* were laid down in 1939, work was suspended shortly after the outbreak of hostilities, and their keels were broken up on the slips during 1944. Two more battleships of the class were planned, but never ordered.

Effectively, the battleships of the Lion class would have resembled those of the King George V, except that their main armament was to be carried in three triple turrets, two forward of the superstructure, and one aft. Instead, a one-off battleship, *Vanguard*, was laid down in 1941, a modern battleship, but one armed with eight 15in. guns, of 1920s vintage. She finally entered service in 1946. By then, though, the age of the battleship had clearly passed, and *Vanguard* existed more as a national status symbol than as a potent member of Britain's shrinking post-war fleet.

King George V class	
Five ships in class: *King George V*, *Prince of Wales*, *Duke of York*, *Anson*, *Howe*	
Displacement:	36,727 tons (standard)
Length:	745ft overall (227.07m); Beam: 103ft (31.39m); Draught: 29ft (8.84m)
Propulsion:	Four shafts; four Parsons geared turbines; eight Admiralty drum boilers, generating 110,000shp
Maximum speed:	28kts
Protection:	Belt: 4.5–15in.; Deck: 5–6in.; Main turrets: 6–13in.; Bulkheads: 12–15in.; Conning tower: 2–4.5in.
Armament:	Ten 14in. Mark VII guns, in two quadruple and one twin turret; 16 5.25in. Mark I dual-purpose QF guns in eight twin turrets; four eight-barrelled 2-pdr pom-poms
Aircraft:	Two (Supermarine Walrus float planes) with hanger; Catapult: one
Complement:	1,422 men

Construction and key dates					
Ship	**Builder**	**Laid down**	**Launched**	**Commissioned**	**Fate**
King George V	Vickers-Armstrong	1 January 1937	21 February 1939	11 December 1940	Broken up 1957
Prince of Wales	Cammell Laird	1 January 1937	3 May 1939	31 March 1941	Sunk by air attack, 10 December 1941
Duke of York	John Brown & Company	5 May 1937	28 February 1940	4 November 1941	Broken up 1957
Anson	Swan & Hunter	20 July 1937	24 February 1940	22 June 1942	Broken up 1957
Howe	Fairfield	1 June 1937	9 April 1940	29 August 1942	Broken up 1957

GERMAN BATTLESHIPS

During the interwar years, the size and potency of Weimar Germany's Reichsmarine was severely restricted. The harsh terms of the Treaty of Versailles (1919) meant that it was reduced to little more than a coastal defence force. Its largest warships were the surviving pre-dreadnought battleships of the Imperial German Navy. While new warships could be built to replace these, modern battleships were off limits. Instead, none could be much larger or more powerful than the armoured cruisers of the previous war. The German response was to develop a new class of 10,000-ton *Panzerschiffe* (armoured ship), which abided by this constraint, yet pushed the restrictions to their very limits. These warships of the Deutschland class were dubbed 'pocket battleships' by the British due to their relatively powerful 28cm (11in.) guns, but in fact they were little more than well-armed heavy cruisers, designed to act as commerce raiders in time of war.

The 28cm gun was chosen because gun calibre was also restricted by the Versailles treaty. While a larger 30cm (12in.) gun would have been preferred, only one barrel of this calibre could be built per year. The smaller calibre was chosen because these restrictions did not apply. The ships carried six of these guns, in two triple turrets. They were no better protected than most heavy cruisers of the period, again due to the displacement constraints of the treaty, and unusually, they were fitted with diesel engines, which limited their speed to just over 28kts, but gave them an impressive cruising range. Three of these Deutschland-class warships were built (*Deutschland*, *Admiral Scheer* and *Admiral Graf Spee*), with the first of them entering service in 1933.

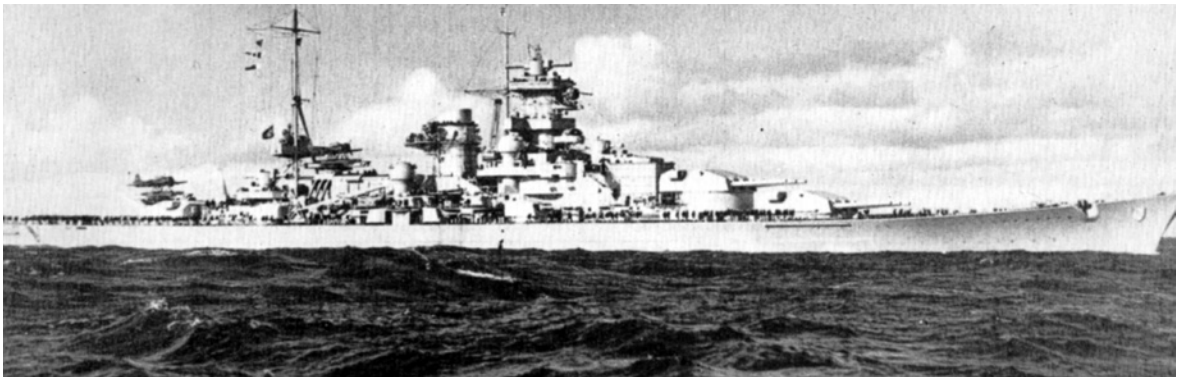
This development led the French to create their own class of modern battlecruiser, to protect their sea lanes in time of war. The battlecruiser itself was a concept whose time had passed, where the naval-design trinity was skewed in favour of firepower and speed, at the expense of armour. These French warships carried an adequate degree of armoured protection, but this was bought at the expense of their firepower, being limited to eight 33cm (13in.) guns, in two quadruple turrets. Despite their

relatively weak belt armour of 22.5cm (8.75in.), for political purposes they were eventually classified as battleships. However, the two battleships of the Dunkerque class (*Dunkerque* and *Strasbourg*) remained battlecruisers in all but name. They also fell within the 35,000-ton limit of the Washington Treaty. This, though, led to a counter-response by the Germans. Plans to build two more *Panzerschiffe* were shelved, as it was decided that, to counter the French, a more powerful type of ship was required.

SCHARNHORST CLASS

By the mid-1930s – the very time the Nazis were consolidating their control over Germany – the Reichsmarine's designers were preparing to breach the restrictions of Versailles. The reasoning was that Nazi Germany had never been bound by the international disarmament treaties of Washington or London. Then, in March 1935, the German Führer und Reichskanzler Adolf Hitler officially abrogated the Versailles treaty. This done, he embarked on a programme of German militarization, which, in

The German battleship *Scharnhorst*, pictured while being fitted out in Wilhelmshaven. Her forward turret 'Anton' has already been fitted, while behind it the raised barbette of 'Bruno' turret can be seen, protected by a temporary shelter. Wood planking can also be seen being laid over her steel fo'c's'le.



The *Scharnhorst* was a beautiful and sleek ship, and, like the Bismarck class which followed, her appearance benefitted from her sharply raked clipper bow. Note the domes on her superstructure covering her main and secondary battery rangefinders.

turn, meant the German fleet would also be expanded. This duly resulted in the pragmatic Anglo-German Naval Agreement (signed on 18 June 1935). The agreement recognized that Germany had the right to expand her navy, but had to do so within the disarmament treaty restrictions imposed upon the other naval powers. This, though, was merely an acceptance of a German fait accompli. By then, the Reichsmarine (renamed the Kriegsmarine in 1935) was already building her first battleships.

Officially, these new battleships, and the two that followed them, were part of the *Schiffbauersatzplan* (Replacement Ship Construction Programme), where the older warships of the Reichsmarine were gradually replaced by modern vessels. So, at least on paper, these ships were simply built to replace two of the old pre-dreadnought battleships that were now due to be scrapped. During the early 1930s, plans were drawn up for an improved version of the *Panzerschiffe*, armed with nine 28cm (11in.) guns, in three triple turrets. Then, by the time the *Dunkerque* was launched in 1935, these had developed into a much larger warship, the armoured belt of which was proof against the 33cm guns of the new French battleships. Also, various configurations of turrets and gun calibres were considered, before the three triple-turret scheme was selected, together with the 28cm gun.

Politically, these were still being described as improved Deutschland-class vessels. In reality, they were fully fledged battleships, albeit ones with a relatively low calibre of main gun. It was this that led the British to regard these new warships as battlecruisers, rather than as battleships. In fact, their armour was better than any battlecruiser afloat, and on a par with the British battleships of the Nelson class. Two of these new ships had been laid down in Kiel and Wilhelmshaven in early 1934, as improved Deutschland-class warships, with two triple turrets. This original configuration was a matter of temporary political expediency, and by that summer the three-turret version was approved.

This, in turn, led to further delays, as the Reichsmarine pressed for a larger gun calibre. The eventual solution was to continue with the 28cm (11in.) gun, but with the ability to retro-fit these ships with 33cm (13in.) guns to match the new French battleships at a later date. In fact, plans were also developed for them to eventually carry 38cm (15in.) guns, if that ever proved necessary. Work on them resumed in earnest in May 1935. Both *Scharnhorst* and *Gneisenau* were launched the following year, and entered service before the outbreak of World War II. By

now, it was clear that these were no mere replacements for ageing pre-dreadnoughts, but were thoroughly modern battleships, with the capability to engage other battleships on the high seas. This, though, was only the start. The next two warships built under the *Schiffbauersatzplan* would be the most powerful battleships afloat, and more than a match for anything the Royal Navy could send against them.

Scharnhorst class	
Two ships in class: *Scharnhorst*, *Gneisenau*	
Displacement:	34,841 tons (standard)
Length:	753ft 11in. overall (229.8m); Beam: 27ft (8.23m); Draught: 32ft 6in. (9.91m)
Propulsion:	Three shafts; three Brown-Boveri geared turbines (*Gneisenau*: Germania turbines); 12 Wagner boilers, generating 165,000shp
Maximum speed:	32kts
Protection:	Belt: 6.75–13.75in.; Deck: 4in.; Main turrets: 6–14in.; Secondary turrets: 2–5.5in.; Bulkheads: 6–8in.; Conning tower: 4–13.75in.
Armament:	Nine 28cm/52 (11in.) SK C/28 gun, in three triple turrets; 12 15cm/55 (5.9in.) SK C/28 guns in four twin and four single turrets; 14 10.5cm/45 (4.1in.) SK C/32 AA heavy guns in seven twin mounts; 16 3.7cm/83 (1.46in.) SK C/30 medium AA guns in eight twin mounts; eight 2cm/65 (0.79in.) C/30 light AA guns in single mounts
Aircraft:	Two (Arado Ar-196 float plane) with hangar; Catapults: one
Complement:	1,669–1,840

Construction and key dates					
Ship	**Builder**	**Laid down**	**Launched**	**Commissioned**	**Fate**
Scharnhorst	Kriegsmarinewerft, Wilhelmshaven	16 May 1935	30 June 1936	7 January 1939	Sunk in action, 26 December 1943
Gneisenau	Deutsche Werke, Kiel	3 May 1935	8 December 1936	21 March 1938	Scuttled, 28 March 1945

BISMARCK CLASS

Meanwhile, the Reichsmarine ordered plans to be drawn up for an even larger class of battleship. In theory, this class would still be built within the restrictive parameters of the Washington treaty. In practice, though, the designers soon breached the treaty displacement ceiling. The first design was for a vessel of 35,000 tons, armed with 33cm (13in.) guns in four twin turrets, but with better armoured protection than the Scharnhorst class. The Kriegsmarine's demand for greater speed forced an increase in weight, due to a more powerful propulsion system. By mid-1935, the gun calibre had been increased to 38cm (15in.), while the displacement was now around 42,000 tons. The Kriegsmarine overcame this displacement problem by simply adjusting the official figures. By now, the

German navy's Department of Ship Construction was able to design what it wanted, without abiding by any international restrictions. The only real design parameter it had was that these new battleships needed to fit through the Kaiser Wilhelm (later the Kiel) Canal.

The move to a higher calibre of main gun was at the insistence of Grossadmiral Erich Raeder, the head of the Kriegsmarine, who was busy laying plans for an even larger and more powerful navy. These new battleships, which became *Bismarck* and *Tirpitz*, would merely form part of his grandiose Plan Z, a decade-long building programme that would create a fleet capable of challenging British naval might. They would be followed by an even larger H-class of battleship, which, if built, would displace over 55,000 tons, and carry 40cm (16in.) guns. The coming of war, though,

The launch of *Tirpitz* on 1 April 1939 in Wilhelmshaven marked the apogee of the Kriegsmarine's battleship building programme. When they entered service in 1940–41, *Tirpitz* and her sister ship *Bismarck* were arguably the most powerful modern battleships afloat.

ended this naval dream. Instead, *Bismarck* and *Tirpitz*, together with *Scharnhorst* and *Gneisenau*, would have to form the core of the Kriegsmarine's wartime surface fleet. Raeder was responsible for increasing the armoured protection of the Bismarck-class battleships, and improving their propulsion system, so they could outpace their British counterparts, and be proof against 15in. or 16in. shells.

One important design feature of the Bismarck class was its well-protected armoured citadel, with an armoured belt 32cm (12.6in.) thick, which then tapered towards the bow and stern. This meant that 70 per cent of the ship was heavily armoured, while even the deck above it was proof against plunging fire. It is easy to see how the German press dubbed *Bismarck* 'unsinkable'. Work began on *Bismarck* in July 1936, and on her sister ship *Tirpitz* the following October. Both were launched in early 1939, but they were still being fitted out when war broke out in September. They were completed in August 1940 and February 1941, respectively. When *Bismarck* entered service, she was the most powerful modern battleship afloat. It was not just due to her impressive main armament of eight 38cm (15in.) guns, her secondary battery of 15cm (6in.) guns or even her formidable anti-aircraft capability: it was the amalgam of her firepower, her protection and her speed that made her so unique – and so deadly.

Bismarck class	
Two ships in class: *Bismarck, Tirpitz*	
Displacement:	*Bismarck*: 41,700 tons; *Tirpitz*: 42,900 tons (standard)
Length:	813ft 8in. overall (248m); Beam: 28ft 6in. (8.7m); Draught: 34 ft 9in. (10.6m)
Propulsion:	Three shafts; three Blohm & Voss geared turbines (*Tirpitz*: Brown-Boveri turbines); 12 Wagner boilers, generating 138,000shp
Maximum speed:	29kts
Protection:	Belt: 10.5–12.5in.; Deck: 6in.; Main turrets: 7–14.25in.; Secondary turrets: 1.5–4in.; Bulkheads: 7.25–10.75in.; Conning tower: 2–14in.
Armament:	Eight 38cm (14.96in.) SK C/34 guns, in four twin turrets; 12 15cm/55 (5.9in.) SK C/28 guns in six twin turrets; 16 10.5cm/45 (4.1in.) SK C/32 AA heavy guns in eight twin mounts; 16 3.7 cm/83 (1.46in.) SK C/30 medium AA guns in eight twin mounts; 12 2cm/65 (0.79in.) C/30 light AA guns in single mounts; *Tirpitz* also had six 53.3cm (21in.) torpedo tubes in two triple launchers, and light AA gradually increased to 40 20mm guns in single and quadruple mounts
Aircraft:	Four to six (Arado Ar-196 float planes) with hangar; Catapults: two
Complement:	*Bismarck*: 2,092; *Tirpitz*: 2,608

Construction and key dates					
Ship	**Builder**	**Laid down**	**Launched**	**Commissioned**	**Fate**
Bismarck	Blohm & Voss, Hamburg	1 July 1936	14 February 1939	24 August 1940	Sunk in action, 27 May 1941
Tirpitz	Kriegsmarinewerft, Wilhelmshaven	20 October 1936	1 April 1939	25 February 1941	Sunk by air attack, 12 November 1944

KMS *BISMARCK*

Bismarck, the lead ship of her class, was the most advanced warship in the world when she entered service in early 1941. Her elegant lines did little to hide her capabilities. While her armament was not particularly unusual, it was supported by a modern computerized fire control system. She was also extremely well protected, at least in terms of her armoured belt. With her impressive speed, *Bismarck* was also fast enough to outpace any battleship in British service.

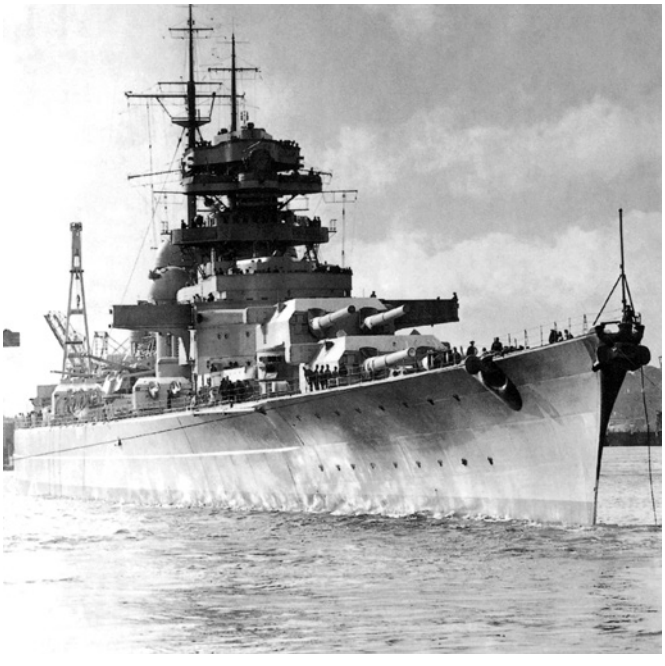
THE STRATEGIC SITUATION

HMS *Rodney*, pictured in home waters shortly before the outbreak of war. Half of her hull was given over to her fo'c's'le and gun turrets, in order to limit the size of her protective armoured belt. Still, the hull shape made her an extremely stable gun platform.

In September 1939, the Royal Navy enjoyed an impressive numerical advantage over the Kriegsmarine. This was particularly true in terms of capital ships, with 11 British battleships in service, and two German ones. However, the British fleet had global commitments. This still meant that the Royal Navy was hard-pressed to counter the threat posed by the German battleships *Scharnhorst* and *Gneisenau*. In addition, during the opening months of the war, a significant quantity of British warships was tied down chasing German commerce raiders. The period known as the 'Phoney War' came to an abrupt end in the spring of 1940. The German invasion of Denmark and Norway was closely followed by the assault on France, Belgium and the Netherlands. The Royal Navy did what it could to counter these invasions. In Norwegian waters, it inflicted significant setbacks. On 8 June, the carrier *Glorious* was sunk by the guns of *Scharnhorst* and *Gneisenau*.

The fall of Norway dramatically altered the strategic situation. Now, German warships could operate from

forward bases in the Norwegian fjords, supported by land-based aircraft. The British patrol line, which until April 1940 had run between Shetland and Bergen, was now pushed back a considerable distance. Due to its length, this was now little more than a screen of cruisers, bridging the gaps between Greenland and Iceland (a passage known as the Denmark Strait), between Iceland and the Faeroes, and the gap between the Faeroes and Shetland. These seas were too rough for destroyers and smaller vessels to maintain a blockade, so cruisers had to be deployed, supported when required by capital ships. The principal task of the Home Fleet at this stage of the war was to prevent sorties by German surface units into the North Atlantic. The situation was further complicated when, in May 1940, the Germans invaded France and the Low Countries. The French surrender that June meant the Germans now had access to French ports on the Atlantic coast, including St-Nazaire with its battleship-sized dry dock, and U-boats had direct access to the Atlantic.



KMS *Bismarck*, lying at anchor off Kiel in September 1940. Extendable wings could be deployed on each side of her bridge, to make the battleship easier to control when entering or leaving harbour, or transiting the Kaiser Wilhelm Canal.

In June 1940, Italy entered the war as a German ally. To improve the strategic position there, Britain's Mediterranean Fleet had to be reinforced, which further weakened the Home Fleet. Although this situation changed following the crippling of the Italian battle fleet at Taranto in November, the situation in the Mediterranean remained tense. There was also the very real threat of a German amphibious invasion of Britain to deal with. This became the Admiralty's priority during the summer and autumn of 1940. Ultimately, the invasion was rendered unfeasible due to the victory of the RAF and its Commonwealth allies in the Battle of Britain. However, during that tense summer and autumn, the Home Fleet stood in readiness to intervene, regardless of the losses it might have suffered at the hands of the Luftwaffe.

Meanwhile, in Scapa Flow, in December 1940, Vice Admiral John Tovey succeeded Admiral Sir Charles Forbes as the commander of the Home Fleet, and was given the acting rank of admiral. His main concern was the prevention of German sorties into the North Atlantic. By then, the Deutschland-class *Admiral Scheer* had successfully broken out into the Atlantic, and spent the winter commerce raiding as far afield as the South Atlantic and the Indian Ocean. She only returned to Kiel in April 1941. Tovey fully expected further sorties. Sure enough, on 22 January 1941, *Scharnhorst* and *Gneisenau* sailed from Kiel, under the command of Admiral Günther Lütjens. On 4 February, Lütjens passed through the Denmark Strait between Greenland and Iceland. For six weeks, the two German battleships ranged the North Atlantic, sinking or capturing 22 Allied merchant ships. On three occasions, they almost clashed with British battleships – *Ramillies* on 8 February, *Malaya* on 8 March and finally *Rodney*

on 16 March. On each occasion, Lütjens broke contact and avoided a fight, and on 22 March, the German battleships reached Brest.

After his success, Lütjens was ordered to conduct a similar sortie with *Bismarck*, accompanied by the heavy cruiser *Prinz Eugen*. On 22 May, Lütjens put in to the Grimstadfjord near Bergen, where his force was detected by an RAF reconnaissance aircraft. Tovey now knew what to expect. He deployed the Home Fleet accordingly, and on 23 May, *Bismarck* found her path through the Denmark Strait blocked by two British capital ships. In the brief engagement that followed, the British battlecruiser *Hood* was sunk, and the brand-new battleship *Prince of Wales* was damaged and driven off. However, *Bismarck* was hit, too, and was losing fuel, so Lütjens decided to head for a French port for repairs.

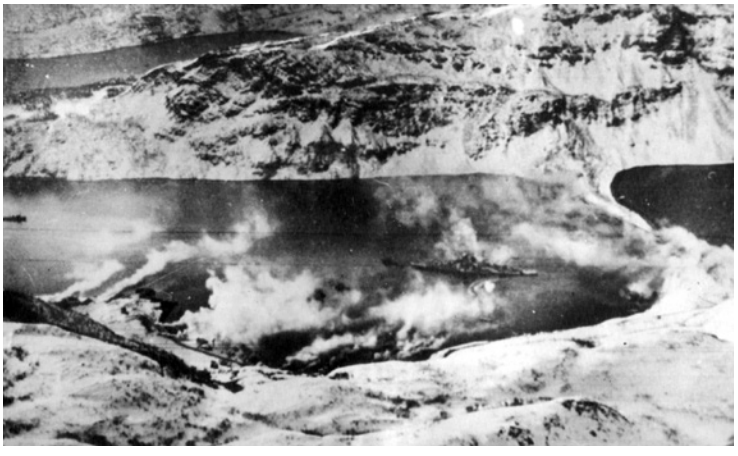
He almost made it. Having detached *Prinz Eugen*, Lütjens evaded his pursuers, which had been shadowing *Bismarck* using radar. However, after an extremely tense day, the battleship was spotted by a land-based reconnaissance plane. Tovey moved in, but his ships lacked the speed to intercept *Bismarck*. Then, on the evening of 26 May, in an air attack by torpedo bombers launched from the British carrier *Ark Royal*, a hit was scored on *Bismarck*'s rudder, irrevocably jamming it. The battleship's crew were unable to repair it, and the following morning, *Bismarck* was overhauled and engaged by two battleships of the Home Fleet. The sinking of *Bismarck* ended the Kriegsmarine's scheme of conducting surface ship sorties into the North Atlantic. From then on, attacks on Atlantic convoys would be left to the Kriegsmarine's U-boat arm.

On 22 June 1941, Germany invaded the Soviet Union. The Soviets called on the Western Allies for help. While there was little they could do directly, they were able to supply the Soviets with weapons and ammunition. In August, the first of numerous Arctic convoys set sail from Iceland, bound for Archangel. Many others followed, but to reach Archangel or Murmansk, these convoys had to pass within range of German bases in northern Norway. This led directly to a redeployment of resources by both the Royal Navy and the Kriegsmarine, to support or threaten these strategically vital convoys. For the Home Fleet, this meant protecting these convoys. After the entry of the United States into the war in December 1941, the scale of these convoys was

HMS *Anson*, returning to Scapa Flow in June 1942, after operating in support of an Arctic convoy. The battleship had only entered service with the Home Fleet a few weeks previously. She spent most of her wartime career performing similar duties in Arctic waters.

stepped up. For their part, the Germans also redeployed aircraft, ships and U-boats to Arctic Norway.

The Channel Dash of February 1942 was driven by the Kriegsmarine's need to redeploy its battleships in Norwegian waters. However, both Scharnhorst-class battleships were damaged during the operation, and after severe damage to *Gneisenau* in a bombing raid, she was decommissioned. When *Scharnhorst* finally returned to service in early 1943, she was sent to Norway, to join the powerful Kriegsmarine Arctic battlegroup there. Until the arrival of *Scharnhorst*, this force was formed around the *Tirpitz*, which arrived in Norwegian waters in February 1942. She was supported by a handful of armoured cruisers, heavy cruisers and destroyers. During 1943, *Tirpitz* made two sorties against Arctic convoys, and while little was achieved, she remained a latent threat. By March 1943, *Tirpitz* and *Scharnhorst* had joined forces in the Altenfjord, near the northern tip of Norway. That September, *Tirpitz* was badly damaged in a daring attack by British midget submarines. Repairs in such a remote location would take several months. By the end of 1943, only *Scharnhorst* remained at large, and able to pose a threat to the convoys. By then, though, the Home Fleet had the resources to deal with her.



The last of the Kriegsmarine's operational battleships was *Tirpitz*. However, after the damage sustained in September 1943, she no longer presented a threat to the Arctic convoys. This photograph shows her in the Kåfjord, an offshoot of the Altenfjord, during an attack by the Fleet Air Arm in April 1944. Smoke generators on the shore are busily deploying a smokescreen to hide the battleship.

In May 1943, Admiral Bruce Fraser succeeded Tovey as commander of the Home Fleet. By then, the Arctic convoys were relatively well protected, and merchant ship losses were decreasing. So, Fraser was able to consider going over to the offensive. If he could use a convoy as bait, *Scharnhorst* might sortie to attack it. Then, using his edge in intelligence gathering and radar surveillance, he could intercept and destroy her. He finally achieved this in late December 1943. The sinking of the *Scharnhorst* ended the Kriegsmarine's bid to use its surface fleet to interdict the Arctic convoys.

In the spring and summer of 1944, Fraser and his successor Admiral Henry Moore carried out a series of naval air strikes against *Tirpitz* as she lay in the Altenfjord. These achieved only marginal success, but during an RAF attack in September, the German battleship was badly crippled. She was finally sunk by RAF Lancaster bombers off Tromsø on 12 November. By then, though, *Tirpitz* was an irrelevance: the battle against the Kriegsmarine had already been won. Certainly, the fighting would continue until the final German surrender, and the Arctic convoys continued to operate, but by the start of 1944, the surface arm of the Kriegsmarine had lost its offensive capability. Technically, it could be argued that the Royal Navy's victory in this prolonged naval campaign was achieved through firepower and technology. However, it was also brought about through skilled planning, well-coordinated intelligence gathering, seamanlike professionalism and an ample supply of good luck.

TECHNICAL SPECIFICATIONS

FIREPOWER

A wartime illustration showing the interior of a triple 16in. gun turret on a Nelson-class battleship. The shells and propellant charges were delivered to the guns using three mechanical hoists, one for each gun. The turret itself was protected by armoured plate up to 16in. thick.

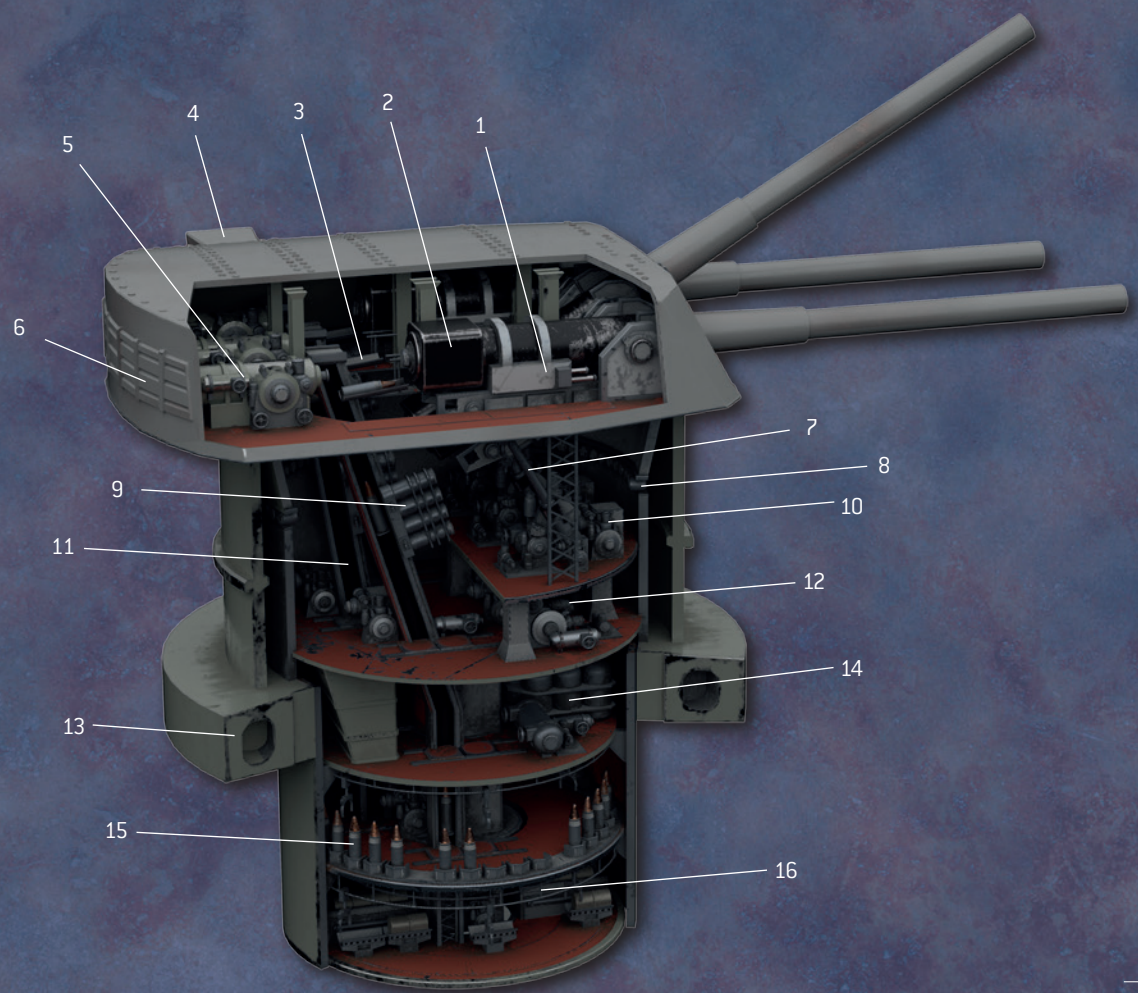
A battleship was built for one reason: it was a floating gun battery, armed with some of the most powerful guns in existence. Her hull had to provide these guns with a stable platform, and one that was strong enough to absorb their recoil. While there was a difference in the range, penetrative ability and explosive power of the various battleship gun calibres, this was less significant than the effectiveness of the gunnery direction systems these battleships used.

Nelson and *Rodney* were designed to carry 16in. Mark I guns, the largest possible calibre allowed by the Washington treaty. These could be elevated hydraulically by 40°, which gave them a maximum range of up to 38,000yds. Hydraulics were also used to train the huge triple turret on its steel rollers, and to feed the shells and charges up from the magazines to the turret. However, this loading process was slowed down by a complex series of mechanical safety interlocks. This was a direct result of British experience during the Battle of Jutland, and while safety was clearly important, so, too, was ease and speed of loading. The system was also plagued by problems.

HMS *RODNEY* 16IN. TRIPLE GUN TURRET

When they first entered service, the triple 16in. gun turrets of Britain's Nelson-class battleships were prone to mechanical problems, largely as both guns and mountings were untested, and because they were supported by one of the most complex loading systems in existence. However, by 1941, these technical problems had all been overcome, and the 16in. guns mounted in the Nelsons comprised some of the most potent naval weaponry afloat. The drawback of the 16in./45 Mark I gun was that it had a slow rate of fire – roughly one round every 40 seconds. This was approximately half the rate of fire of the guns mounted in *Bismarck*. Like *Bismarck*, these guns were loaded hydraulically. The elevating and training mechanisms were also hydraulic, while electrical power was used to operate the hoists.

1. Gun recoil system
2. Gun breech
3. Shell loading tray
4. Rangefinder
5. Hydraulic rammer
6. Exhaust vents
7. Gun elevating gear
8. Roller track (for turret training)
9. Main shell hoist
10. Turret training gear
11. Main cordite hoist
12. Hydraulic power plant
13. Turret barbette
14. Turret machinery compartment
15. Shell handling room
16. Cordite handling room



The design of the King George V-class battleship was an exercise in wartime compromise. The unusual main gun configuration of two quadruple turrets and one twin turret was due to weight constraints, as the Admiralty insisted that the battleships be protected by a substantial armoured belt.

During the 1930s, this malfunction-prone process was streamlined, and most of the problems were overcome. However, it still remained cumbersome. Any shortcomings of the British 16in. gun were limited to the loading system, not the weapon itself. Its effectiveness was ably demonstrated in May 1941, when *Rodney*'s 16in. shells pounded the *Bismarck* into a shattered hulk. A simpler loading system was designed for the 14in. Mark VII gun fitted in the King George V class. The barrels themselves were of all-steel construction, rather than wire-wound, and these were mounted in two quadruple turrets ('A' and 'Y'), and a twin turret ('B'). The guns themselves could be elevated to 40°, which gave them a maximum range comparable to the 16in. gun.

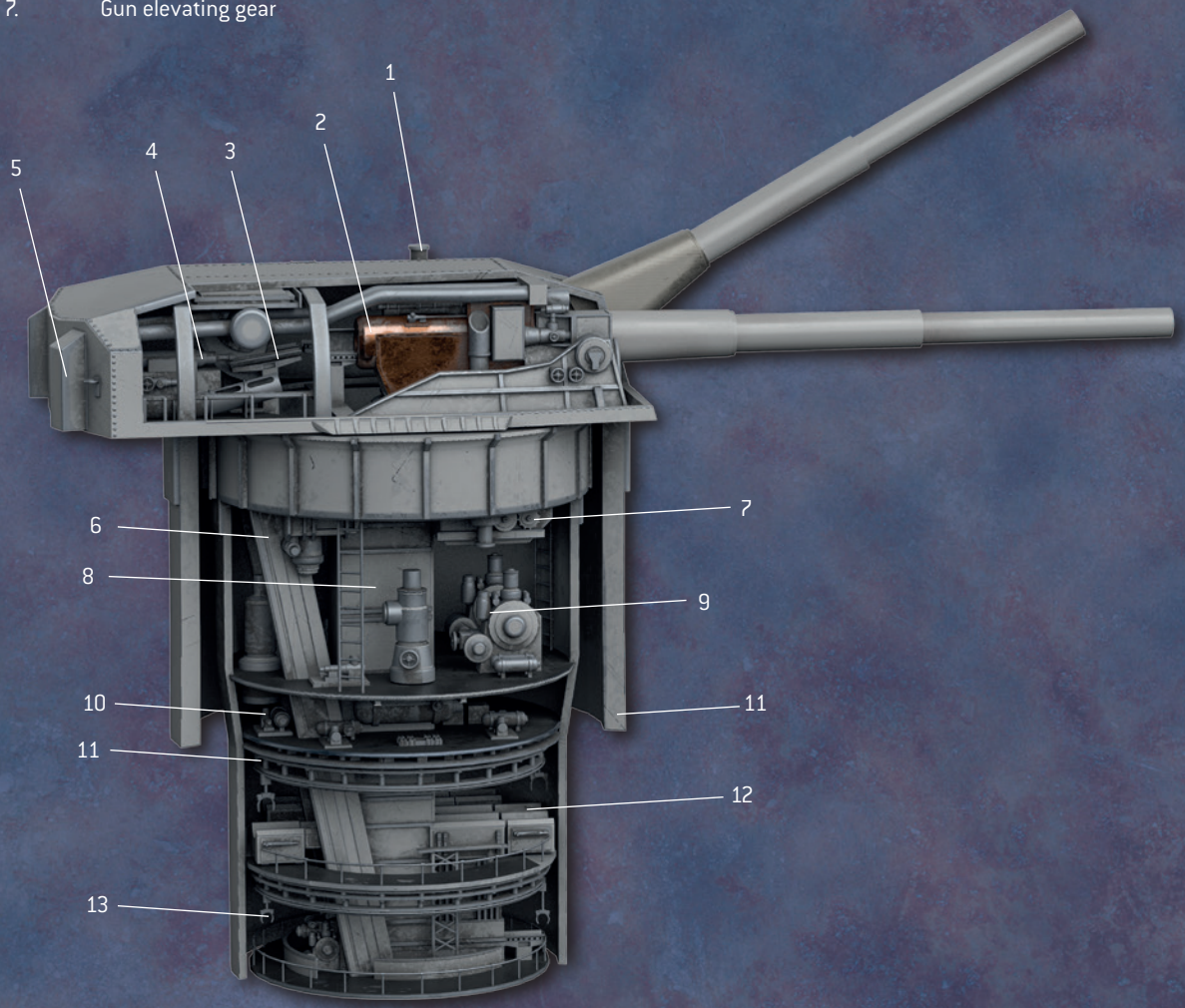
The loading system was simpler than that for Nelson-class ships, but it was just as troublesome. While problems with the 16in. gun were ironed out in peacetime, there was no such luxury for these 14in. pieces. During the Battle of the Denmark Strait, the 14in. mounts of *Prince of Wales* were plagued by mechanical breakdowns. Then, when *King George V* engaged *Bismarck*, her loading systems performed so badly that at one stage, only two of her ten guns were operable. These teething problems were gradually ironed out, and by early 1943, they had been overcome. The performance of *Duke of York* at the Battle of North Cape showed what these guns were capable of, particularly when supported by a modern fire control system.

KMS *BISMARCK* 38CM TWIN GUN TURRET

Bismarck carried a powerful main armament of eight 38cm (14.96in.) guns, mounted in four twin turrets. These were the largest guns ever carried in a German warship. Their official designation was 38cm SK C/34, with SK being an abbreviation of *Schelladekanone* (quick-firing gun), while C/34 referred to the *Construktionsjahr* (year of design), which in this case was 1934. In *Bismarck*, each turret was designated by a name. From bow to stern these were 'Anton', 'Bruno', 'Caesar' and 'Dora'. Of these, 'Bruno' and 'Caesar' were superimposed, or elevated on barbettes, so they could fire over the top of 'Anton' and 'Dora' turrets, respectively.

The turret itself rested on a roller track, and was trained hydraulically. The guns, too, were elevated using hydraulics, powered by electrical pumps. Electrical power was used to operate the shell hoists and the loading mechanisms.

1. Telescopic gun sight
2. Gun breech
3. Shell loading tray
4. Hydraulic rammer
5. Exhaust trunking
6. Auxiliary hoist
7. Gun elevating gear
8. Main ammunition hoist
9. Hydraulic power plant
10. Turret machinery compartment
11. Roller track (for turret training)
12. Cartridge handling room
13. Shell handling room



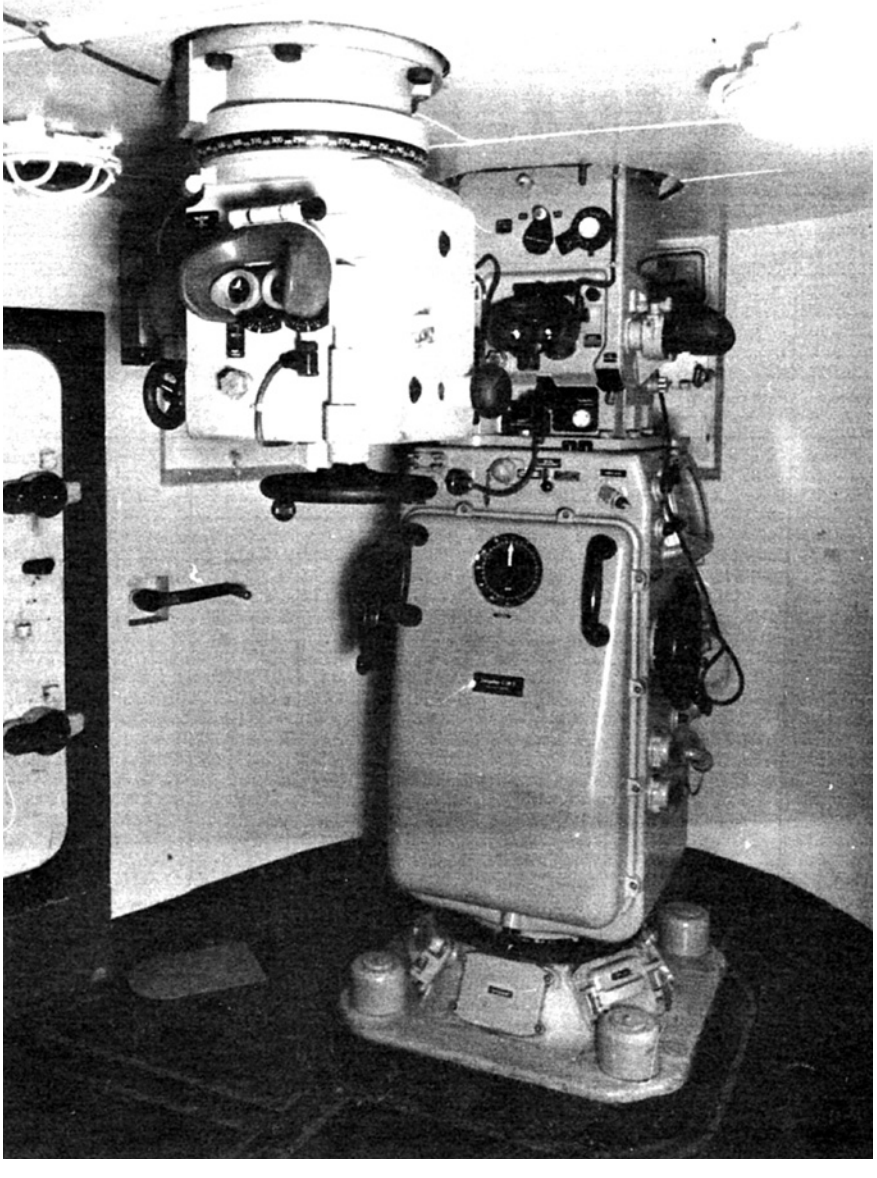
The forward triple 28cm gun turrets of a Scharnhorst-class battleship, pictured during a gunnery exercise. The picture is taken from the roof of the battleship's armoured conning tower, and the electric rangefinders protruding from the sides of each turret can be seen.

In that battle, *Scharnhorst* was armed with the 28cm/52 (11in.) SK C/28 gun – nine of them in three triple turrets. This was an improved version of the gun and mount that had been fitted in the Deutschland-class armoured cruisers, and these had proved to be highly reliable. In the Scharnhorst class, these guns had a maximum elevation of 40°, powered by an electrical drive. This gave them an impressive maximum range of 44,760yds – further than the battleships' gunnery direction system could deal with. These proved extremely efficient, but the drawback here was the relatively low calibre of the shell. Although this limited its penetrative power, this was partly offset by its greater rate of fire and impressive range.

By contrast, the 38cm (14.96in.) SK C/34 guns mounted in the Bismarck class were elevated using hydraulics, but powered electrically, while the turret training was electrically driven, riding on steel spheres. Here, the maximum elevation was 30°, but this did little to limit the range of the projectiles, which at just under 40,000yds was slightly more effective than the 16in. guns carried in the Nelsons. Incidentally, similar 38cm guns were installed in turrets that were earmarked for the *Gneisenau*. However, when the battleship was damaged in early 1942, these guns were used as coastal artillery pieces instead. It has been claimed that this was the fastest-firing battleship gun of the war. In fact, while a speed of three rounds per minute was attempted, official reports state that in May 1941, *Bismarck* suffered from mechanical loading faults, which reduced her rate of fire somewhat. So, the performance of each of the four guns used in these four battleship classes varied slightly, but ultimately their effectiveness depended on other factors: the ability of the firing ship to direct these shells at the enemy, and the effectiveness of the target ship's armour.

GUNNERY DIRECTION

A battleship's firepower was only as effective as the system it used to direct the fire of her guns. Gunnery direction (or fire control) systems were developed before World War I as a way of coordinating the fire of all of a warship's main guns. Essentially, this meant using a telescopic sight to find the bearing of an enemy ship, and then making sure that all of the ship's gun turrets were pointing at the target. These bearings were offset slightly from turret to turret throughout the firing ship, to make sure all of the salvo landed on the same spot. Then, a rangefinder was used to measure the range to the target. By World War I, this basic system had been developed into a highly complex



The interior of one of *Bismarck*'s gun directors. The gun director itself stands on a plinth, next to the optical telescope serving the 10.5m rangefinder mounted on top of the position. This director was fed the firing data from the battleship's analogue computer, and passed this on to the turrets.

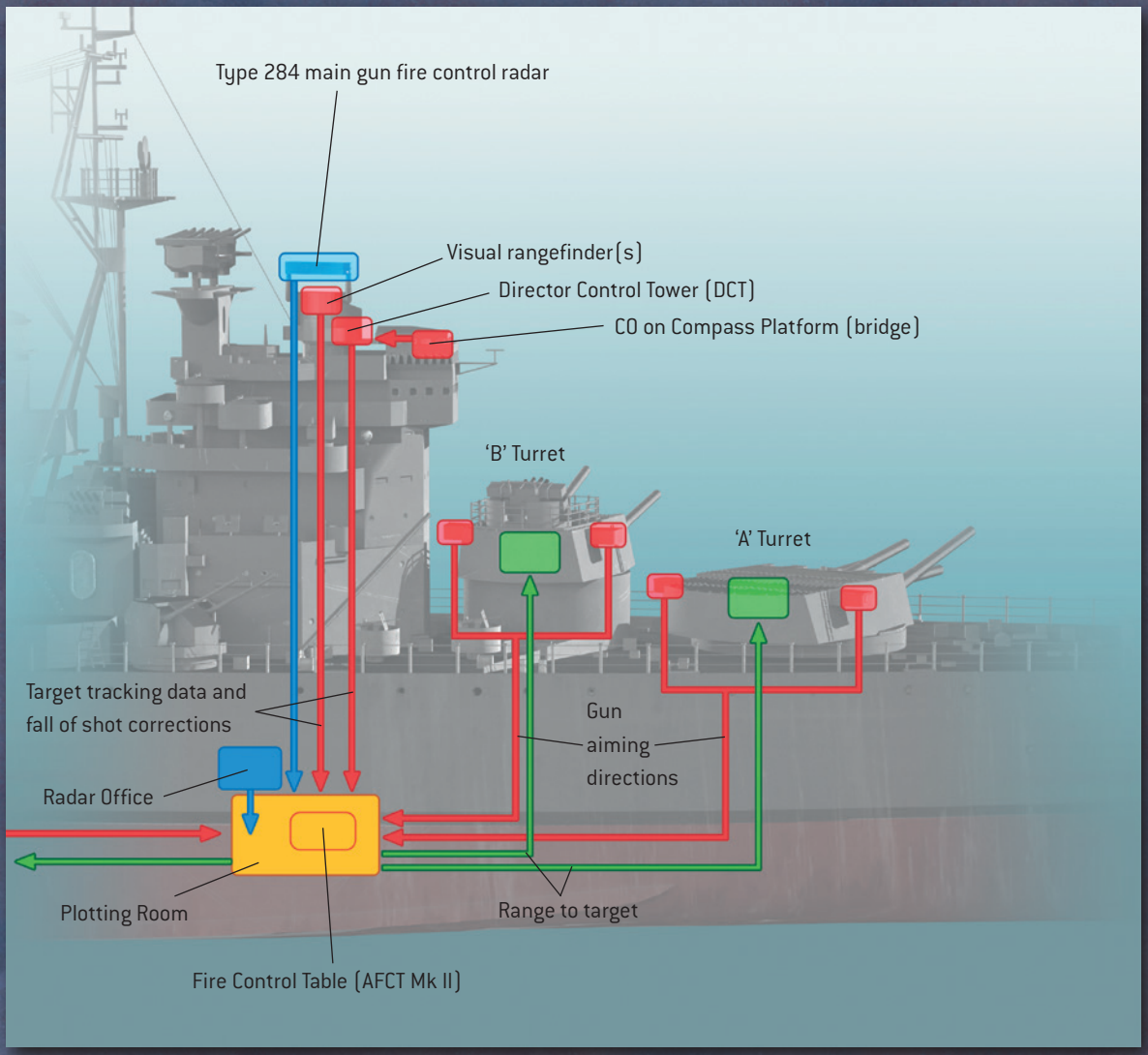
The 38cm (15in.) armour-piercing shells used by the guns of a Bismarck-class battleship weighed 800kg (1,764lb) each, and so had to be loaded mechanically. Behind each shell, two propellant cartridges were also hydraulically rammed into the gun's breech before the loading cycle was complete.

system with a mechanical plotter at its heart. The speed, course and bearing of firing ship and target were entered into it, as well as factors such as wind speed and air temperature. This was then converted into an accurate firing solution in terms of elevation and bearing for each gun.

The battleship's gunnery officer could then coordinate the firing of the ship's salvos, after this solution was passed to every turret. Then, the ship's guns could be fired together, in a single salvo. Typically, these would aim a little ahead of the target, to compensate for the flight time of the shells. A spotting team would then observe the shell splashes to see if the range needed to be altered. Each salvo was then corrected until the shells straddled (landed around) the target. The gunnery officer usually

GUNNERY DIRECTION

The Gunnery Direction system used in both British and German battleships was remarkably similar, save for differences in the quality of optics and fire control computers, and in fire control radar. This diagram shows the arrangement on board a King George V-class battleship. Information gathered from visual rangefinders or the fire control radar was fed into the Fire Control Table, turned into a set of training and elevation instructions and then transmitted to the gun turrets. Once the guns were ready to fire, the order to fire was issued from the Control Officer located inside the DCT.



operated from within a protected Director Control Tower (DCT), which was usually sited on top of the battleship's superstructure, where he would have a clear view of the target. By contrast, the plotting room was usually located below decks, inside the ship's armoured hull. If the DCT was hit, the battleship could rely on a secondary one, usually located further aft. Similar positions were used to direct the fire of the battleship's secondary battery, or its anti-aircraft guns.

In British battleships, these gunnery calculations were done by the Admiralty Fire Control Table (AFCT), with the Mark I version installed in the Nelsons, and the improved Mark II in the King George V class. A plotting officer supervised the smooth operation of the table in the plotting room, and data generated by the AFCT was fed to the DCT and the turrets. The German navy employed a similar but somewhat simpler system, developed by the Dutch company Hazemeyer, which was secretly funded by the German state. Its C/35 system was similar to the British AFCT, except it was more automated, and better resembled an analogue computer as we might understand it today.

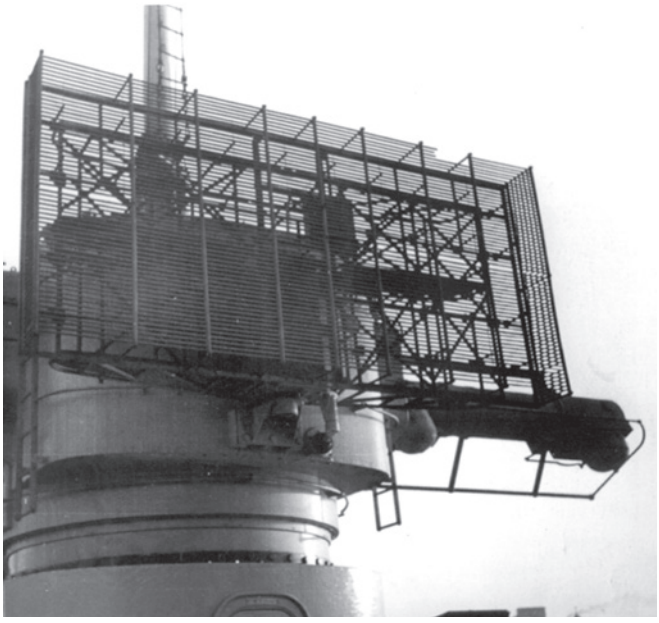
This was installed in the Scharnhorst class, while the larger and more complex C/38 system was fitted into the Bismarcks. Once the system computed the targeting information, a German battleship would normally fire a 'ladder' – three salvos spaced 400m (437yds) apart, usually using half-salvos of up to half the ship's guns. Then, when a straddle was achieved, a full salvo would be fired. This varied from the British method of gradually 'walking' the salvos onto the target. By 1941, both systems were very reliable, but on German ships this was supported by some of the best gyro-stabilized rangefinders of the period. Germans excelled at optics, and on both the Scharnhorsts and the Bismarcks these gave their gunnery teams a slight edge in terms of rapidly obtaining accurate targeting information to feed into the computerized fire control system.

The efficiency of both systems was demonstrated during Operation *Rheinübung* – the *Bismarck* sortie of May 1941. *Prince of Wales* succeeded in hitting *Bismarck* three

GERMAN 10.5M RANGEFINDER DISPLAY

German battleships placed a much greater reliance on optical fire control, with two powerful 10.5m rangefinders mounted in the superstructure of the Bismarck class, with additional local rangefinders on the main turret tops. These were augmented by an additional suite of 7m rangefinders, as well as 3m night-vision rangefinders. German optics were of the finest quality – superior to their British counterparts – and proved their worth in action in the Battle of the Denmark Strait. Here, we see *Prince of Wales* being straddled by a 38cm salvo from *Bismarck*.

times, and straddling with her second salvo. *Bismarck*'s gunnery was equally impressive, quickly achieving straddles on both *Hood* and *Prince of Wales*, before destroying the former and driving off the latter. A few days later, *King George V* was equally successful at targeting *Bismarck*, although she encountered a few problems due to malfunctioning equipment and guns. *Rodney*'s initial salvos were poorly spread out, but when the range dropped to within 20,000yds, her gunnery improved markedly. Part of this, though, was due not to her gunnery direction, but to the lack of recent gunnery training by her crew. By then, the King George V-class ships were already fitted with fire control radar systems, and while these were still not as efficient as later versions, they demonstrated the future potential of radar fire control.



The 'bedstead' array of *Bismarck*'s after FuMO 27 surface-search radar. She carried three radar arrays, on her forward and after superstructure, and on the roof of her bridge. At the time of her loss, though, these sets were known as FuMG40G (g0) arrays.

Radar had two functions. The first was detection, where surface-search or air-warning radar were used to locate an enemy warship. The effectiveness of radar detection increased markedly as the war progressed, and so, too, did the range at which enemy ships could be spotted. The real value of it, though, was to give a battleship the chance to detect an enemy at night, or in low visibility. The second function of radar was as a means of providing fire control information, which could then be fed into the battleship's main gunnery direction system. Both functions used different radar types. The frequency, bandwidth and even operation was different for a search radar to that of a fire control one. So, as the war progressed, warships tended to embark a variety of

BRITISH TYPE 284 RADAR DISPLAY

The FuMO 27 system fitted in German Bismarck-class battleships was primarily a surface search radar, for detecting large targets at ranges up to 30,000m. However, for targeting purposes, its effectiveness was limited to 12,000m. By contrast, British battleships of the King George V class were fitted with Type 284, a dedicated main gun fire control radar. It had a surface search capability, being able to detect targets up to 48,000yds (43,891m) away, but for effective fire control purposes, range was limited to 24,000yds (21,946m). Unlike modern Position Plan Indicator (PPI) radars, with their top-down displays, these presented a rangefinding display of the kind shown here. These displays, though, were extremely accurate.

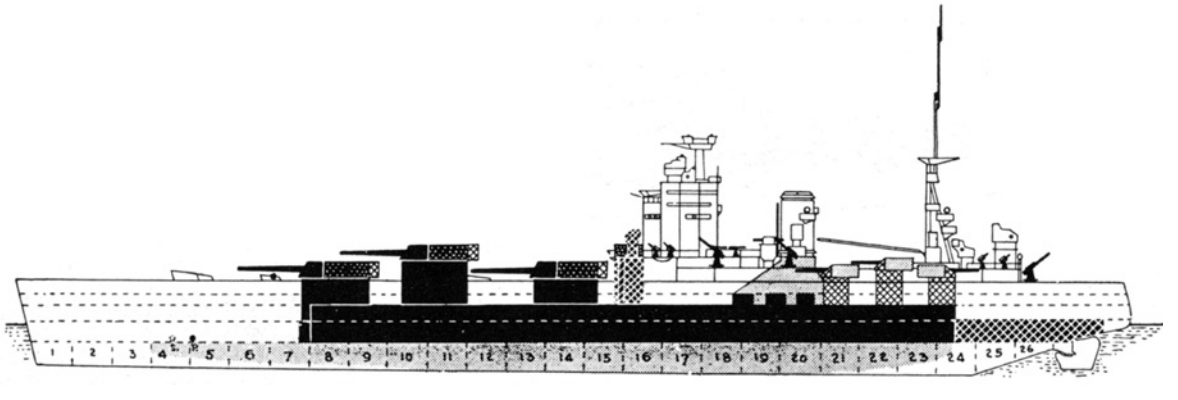
electronic sensors, all with specific, although sometimes overlapping, functions. In most battleships, radar sets were usually mounted in the masts or atop the superstructure, to provide the best possible range and coverage.

The Scharnhorst-class ships were fitted with the FuMO 22 Seetakt set, which combined search and fire control functions into one relatively inefficient radar set. In 1941, it was replaced by the FuMO 27 set, which, in theory, had a range of around 24,000yds. In practice, its detection range was roughly between a half and one-third of that, depending on sea state and atmospheric conditions. The Bismarck class mounted an improved Seetakt version, the FuMO 23 set, as well as FuMO 26, an air-search radar. In 1943, *Tirpitz* replaced her FuMO 23 with an improved FuMO 26 set, which had a far more efficient fire control component. In contrast, though, British battleships upgraded their radar systems throughout the war. By early 1941, the Nelson class carried basic search radars, providing a limited air- and surface-search ability, but during late 1941 and 1942, they received Type 284 fire control radars, supporting their main guns, as well as improved surface- and air-search radars.

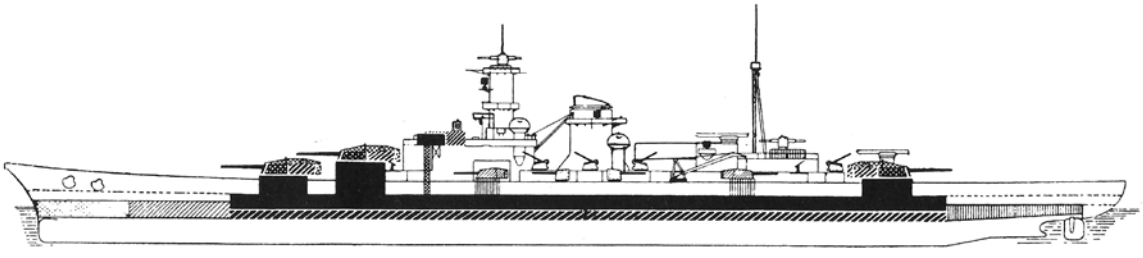
The King George V-class ships were given improved air-search radars as well as the Type 284 fire control radar, and other fire control radars supporting their dual-purpose guns. As the war progressed, these sets were upgraded, and by the time of the Battle of North Cape, the *Duke of York* was festooned with radar, carrying 12 sets: the Type 273Q surface-search set, with a range of 23 miles, her Type 281 air-search radar, and several fire control radars, including the Type 284, which could direct her guns at their maximum range. This made the *Duke of York* and her remaining sister ships some of the most sophisticated radar platforms in the Royal Navy.

PROTECTION

Protection against enemy fire was provided by heavy armour, which was usually concentrated in an armoured belt that ran all or part of the way along the hull of the ship. If this proved impossible due to design or weight constraints, the armoured belt was concentrated around the ship's guns and magazines, the plotting room and its



The armour scheme of a Nelson-class battleship, as published in a wartime edition of *Jane's Fighting Ships*. Due to her 'all or nothing' scheme, her armoured belt was concentrated around her main guns and magazines, and her engine rooms.



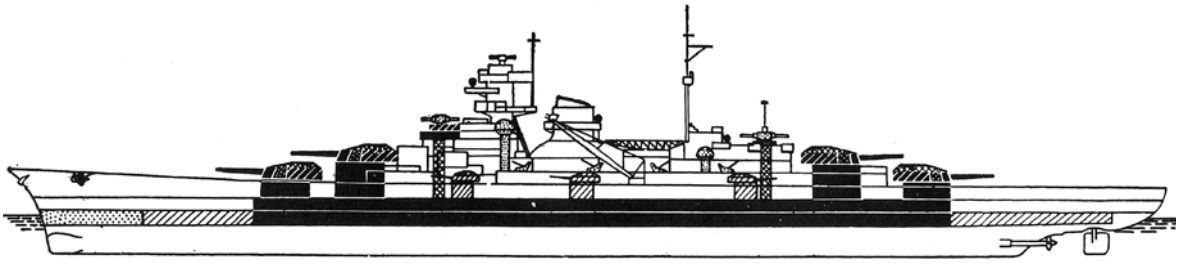
propulsion system. These, after all, were regarded as the battleship's 'vitals'. For example, the Nelson class had an 'all or nothing' protective scheme, where, to save weight, the armoured belt was concentrated in parts of the ship, leaving the rest of the battleship with only the thinnest of armour – proof only against shell splinters. Similarly, while the Bismarck class had an armoured belt of 32cm (13in.)-thick Krupp cementite (iron carbide) steel that extended for three-quarters of the length of the ship, the bow and stern of the ship were left with virtually no protection, apart from a thin 8cm (3.25in.) belt running along the ship's waterline.

The protective scheme of battleships of the Scharnhorst class was more conventional, with the thickest protection concentrated in the armoured belt, above the waterline. A thinner belt extended below the waterline, and similarly, the turret armour was concentrated on the front face.

Usually, this armoured belt was tapered at the top and the bottom, which meant the hull close to the upper deck or below the waterline was not as well protected as the main belt. In addition, the armoured deck of a battleship was armour plated, to protect the 'vitals' from the plunging fire experienced at long range. Usually, the upper deck was only protected against shell splinters – the main armoured deck was a deck or two below this. Then, throughout the ship, bulkheads were also armoured, particularly at the two ends of the main armoured belt. Effectively, this can be imagined as a steel box, or armoured citadel, protecting the 'vitals' from fire from every direction. Usually, though, the underside of this box was relatively poorly protected by a multi-layered ship's bottom, which offered some protection against mines.

Further heavy armour was also provided for the main gun turrets, although here the thickness varied, with the greatest protection being concentrated on the faces of the turrets. The barbettes that held the loading and traversing mechanisms of the turrets were also well protected, as was the conning tower – the bridge, in effect, as well as the DCT. These formed a sort of protected appendage to the armoured citadel. Also, additional protection was usually provided to secondary gun positions, although here the degree of protection was usually considerably less than the main fighting areas of the ship outside the citadel. Finally, protection against torpedoes was usually provided by a torpedo bulkhead, which formed a vertical compartment along the side

The *Bismarck* class was protected by a thick armoured belt, which extended up the barbettes to the gun turrets, and to the conning tower (bridge) and rangefinders. The bow and the stern sections of the ship were less well protected.

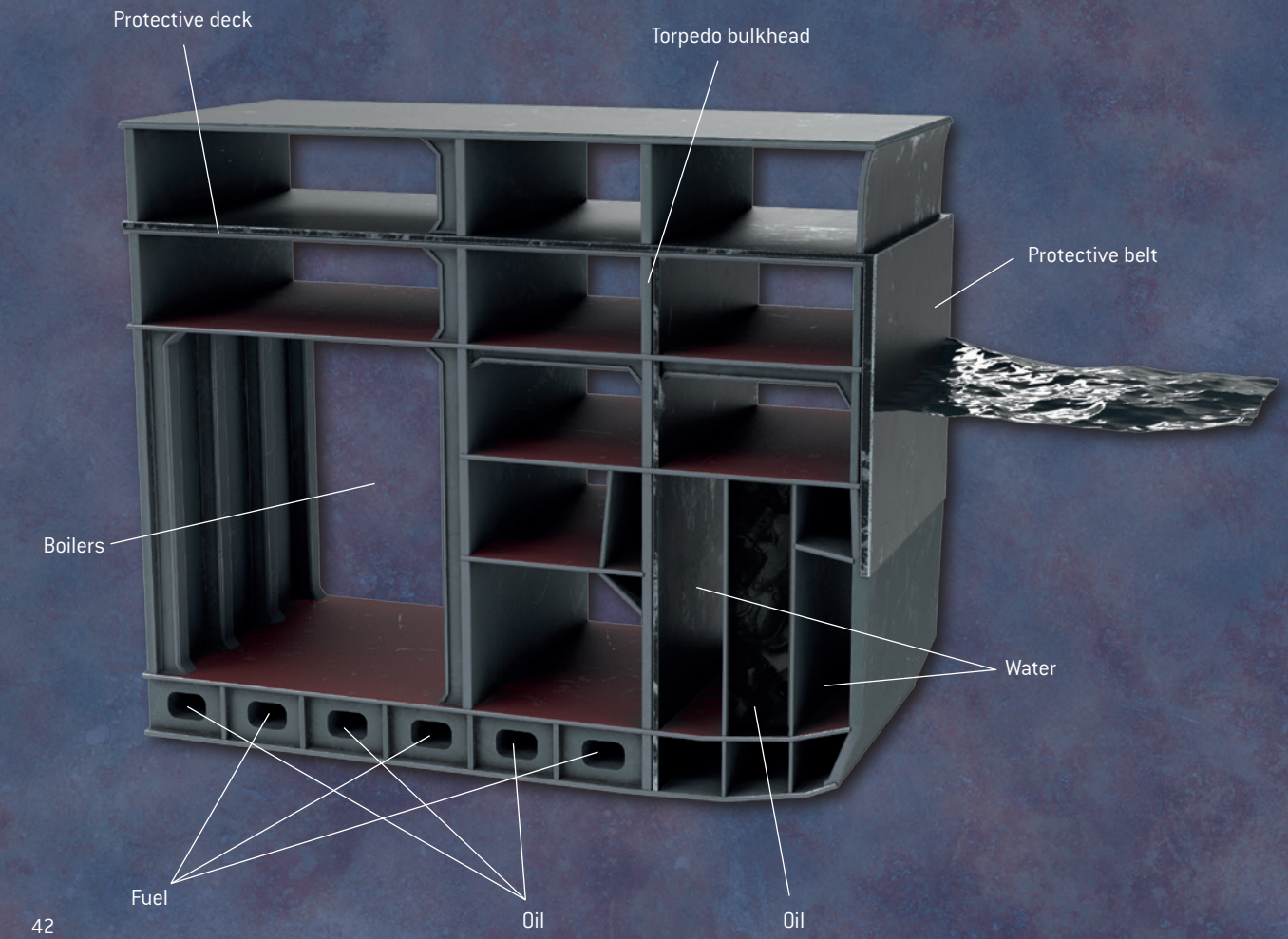


ARMOUR

In these two illustrations, the armoured protection of two battleships is compared. They comprise a midships cross-section of the port side of the British King George V class, and a similar cross-section from the German Bismarck class. Both show the protection of the battleships' armoured citadel, encompassed by the armoured belt of the outer hull, and the protective deck that closed off the top of this citadel. This protective deck was designed to protect the battleship from long-range plunging fire of the kind that destroyed the battlecruiser *Hood*, while the belt was her defence against more direct fire, striking the ship at shorter ranges.

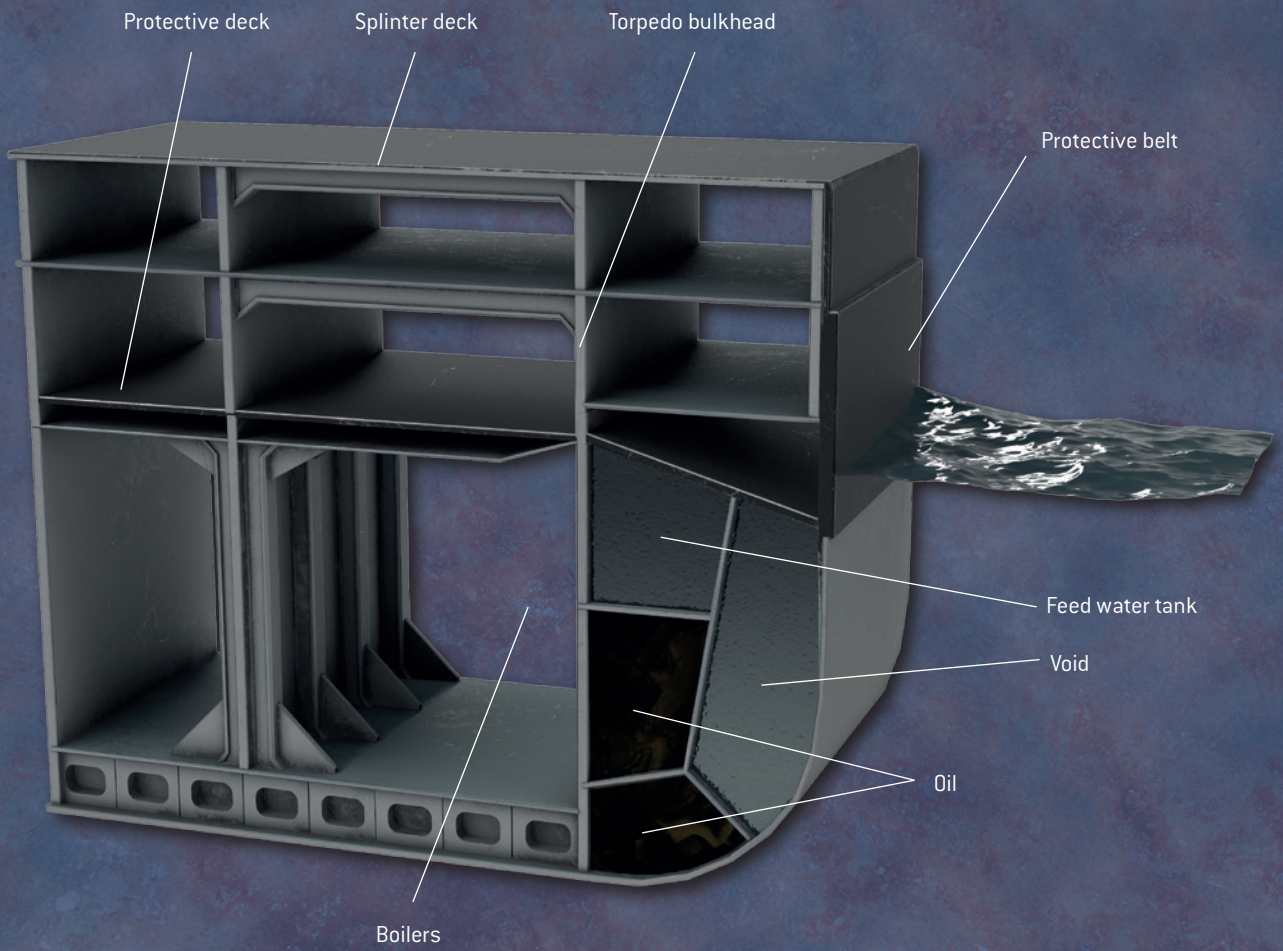
King George V armoured protection (amidships)

In the King George V class, the protective deck was substantial, with a thickness of 5–6in. (12.7–15.2cm), and extended to the top of the protective belt. This belt itself varied from 14 to 15in. (38.1–35.6cm). It extended below the waterline, while below it was a much thinner armoured belt. Some way inside the hull was a torpedo bulkhead 2in. (5.1cm) thick, running parallel to the ship's side. Additonal protection was provided by outer compartments below the waterline, used as oil and water tanks, which could lessen the impact of an enemy hit.



Bismarck armoured protection (amidships)

In the Bismarck class, a similar system was adopted. The protective deck was 3.15in. (8cm) thick, but it was sloped downwards at the edges, to meet the lower portion of the armoured belt. The slope was intended to lessen the destructive impact of a shell penetrating the belt armour. The belt itself was 12.6in. (32cm) wide, surmounted by a thinner upper belt of 5.71in. (14.5cm). A 3.1in. (8cm)-thick belt protected the upper deck. The vertical torpedo bulkhead was 1.77in. (4.5cm) thick. As in the King George V class, the spaces outside it were used as fuel or water tanks, although the outermost space was empty, to enhance underwater protection.



of the ship. This was designed to absorb the impact of a torpedo hit, and to limit the extent of any flooding.

Various types of steel armour were used during this period, but in general, it was either face-hardened (sometimes known as cemented) or else homogenous. The former had a hard outer shell that was designed to break up the incoming shell, while a softer, less brittle backing prevented the outer face-hardened plates from shattering. As the name suggests, homogenous armour had a uniform consistency, and it spread the impact of the hit over a wider area. Armoured belts and turret faces tended to be face-hardened, while deck armour and thinner auxiliary belts tended to be made from homogenous steel. When used as deck armour, it also helped to contain the shell fragments generated by an explosion, or even from a near miss where the shell broke up into fragments when it hit the water.

PROPULSION

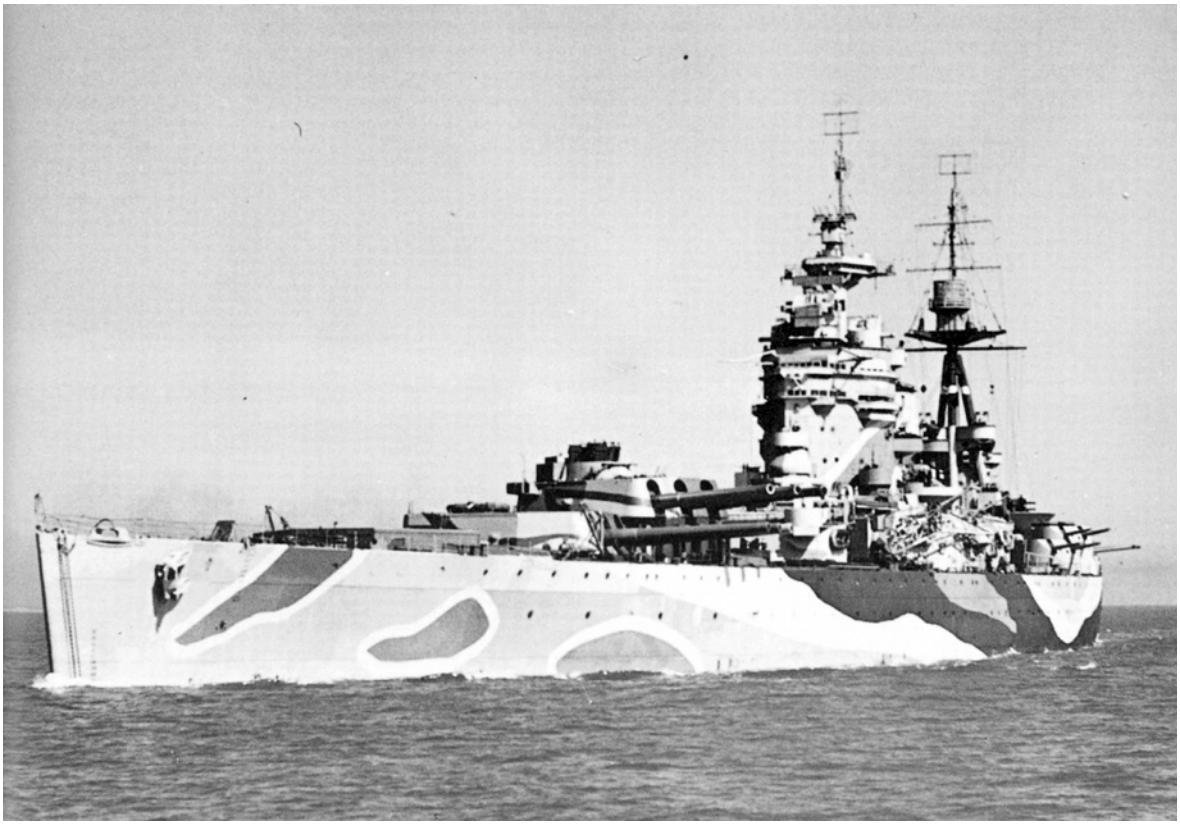
The four classes of battleship covered in this work all shared the same form of propulsion, relying on steam generated in boilers to power a series of turbines. Each steam turbine turned a single propeller shaft. While the basic systems remained the same, there were minor differences in configuration and performance. The Nelson-class ships were driven by a pair of geared steam turbines, located abreast of each other in two engine rooms, situated forward of their four associated boiler rooms, each containing two boilers. Although this system generated over 45,000shp, the battleships only attained a top speed of just over 23kts. This was actually slower than the Queen Elizabeth-class battleships of World War I vintage. By 1940, these propulsion systems were showing their age, and the two battleships were lucky to attain much more than 20kts.

For the King George V class, built a decade and a half later, the designers opted for a more powerful configuration, with four more-efficient geared turbines powering four propeller shafts. Here, a more staggered arrangement was adopted, with the turbines in the two forward engine rooms driving the outboard shafts, and the two engines further aft driving the inboard ones. Forward of each pair of engine rooms was an attendant boiler room, each containing two boilers. This system generated 100,000shp, more than double that of the Nelsons, but the maximum speed of these battleships was still no more than 28kts.

At first, the German designers of the Scharnhorst class considered using diesel propulsion, of the kind used in the Deutschland-class armoured cruisers, but in the end, a more conventional steam plant was adopted. Here, three geared turbines drove three propeller shafts, and were placed in three engine rooms: two abreast of each other, with the third driving the central shaft astern of them. Initially, cruising turbines were fitted to augment the main engines, but these were subsequently removed. Each turbine was powered by steam from 12 boilers, three in each of four boiler rooms. So, each boiler room contained a turbine associated with one of the three turbines. This system generated over 160,000shp, giving these battleships an impressive top speed of 32kts.

A similar system was adopted for the Bismarck class, with three geared turbines set in three engine rooms, driving three propeller shafts. Two engine rooms were abreast of each other and the third was immediately aft of them. This after turbine powered the central propeller shaft. The 12 boilers were divided equally between six boiler rooms, three abreast of each other, sited forward of the three engine rooms. Here, a pair of boiler rooms powered each turbine. These generated 163,000shp, giving the battleships of the Bismarck class a top speed of 30kts.

In all of these ships, the main propulsion system was sited below the waterline, protected by an armoured citadel. The main machinery spaces were flanked by others: auxiliary machinery rooms, electrical plant rooms, and in the case of the German ships, diesel motor rooms, used to augment the vessels' electrical plants. Not only did these provide light on board, but also provided power for the gun turrets, ammunition hoists, pumps and secondary batteries. The result was a complex but extremely efficient integrated power plant, generating enough electrical or auxiliary steam power to serve a small town. The boilers of these battleships were heated using fuel oil, which was stored in a network of small compartments located just inside the outer hulls of these ships. So, if one fuel tank was punctured by an enemy shell, the compartment could be sealed off to minimize the loss of fuel. A pumping system ensured that this fuel oil, as well as feed water, was delivered where it was needed, and in the necessary quantity, without affecting the stability of the ship.



HMS *Rodney*, pictured in the Clyde in May 1942, after emerging from a wartime refit. By this stage of the war, she had been fitted with a powerful suite of search and fire control radars. However, her engines were failing her, and by this date she could barely make 20kts.

THE COMBATANTS

BRITISH BATTLESHIP CREWS

The galley of a Nelson-class battleship. Catering for over 1,360 men was no easy matter, and the professionally trained catering staff prepared the food, which was then distributed to the battleship's various messdecks. Separate dining arrangements were made for the officers, the captain and the admiral.

In September 1939, the Royal Navy had a well-trained and highly professional body of men at its disposal. Most of this force of 131,000 men comprised long-service men, who had joined as boys, and remained in the navy for up to 22 years. While some may have resented this longevity of service, many welcomed it, particularly during the pre-war years of the Great Depression. Some then served for another five years with the Royal Naval Reserve (RNR), which provided another body of 70,000 men who could be called up in time of war. In the pre-war navy, longevity of service was rewarded by service stripes, and for some it counted more than ability, enthusiasm or discipline. However, these often hard-bitten long-service men were thoroughly trained, and steeped in the ways of the service. In most cases, they could be relied upon to do their job with competence and professionalism. In other words, they formed the backbone of the service.

With the coming of war, the Royal Navy underwent a dramatic expansion, first with reservists called to the colours, and then a new and even larger wave of

An important part of the day on board a wartime battleship of the Royal Navy was the issuing of the rum ration. This was issued daily, to all sailors over the age of 20. A representative of each messdeck collected the ration for his shipmates.

Hostilities Only (HO) ratings, who were drafted purely for the duration of the war. These new recruits were either conscripts or short-term volunteers, and their training began with adapting them to what was a completely unfamiliar environment, before the business of professional training could begin. By the end of the war, the navy's ranks had swelled to 783,000 men, as well as 72,000 women, who fulfilled shore-based duties. In theory, all naval ratings were attached to one of three 'home ports' – Chatham, Portsmouth and Devonport (Plymouth). In wartime, additional, specialist manning bases were established, but the crews of all of the Royal Navy's battleships were linked to one of these home ports.

The Royal Navy's manpower was divided into a number of branches. Of these, the seaman branch was the largest, and included gunners, torpedomen and radar operators. Stokers – the ship's engineers – formed the next-largest branch, and, again, their numbers included some of the more highly trained specialist groups, such as mechanics and electricians. Artificers were a more highly trained sub-group within the branch, for the engine room, ordnance and electrical specialisms. Signallers included men trained both in visual and radio signalling, while the remainder of the ship's company consisted of medical, administrative and domestic staff, such as sickbay attendants, writers, cooks and stewards. Finally, there were the Royal Marines, who made up around 10 per cent of the total naval manpower. On board battleships, they tended to serve as gunners, and often manned their own turret.

The melding of the pre-war navy with the wartime one was a difficult process. The wartime navy was a real melting pot of British society, and after basic training and then further training in their branch or specialism, these men were thrust together, to serve alongside each other for what could be years. What made this work – and underpinned the whole professionalism of the Royal Navy – were the non-commissioned officers

The crew of a British battleship were berthed in messdecks, which were usually divided according to the crews' branch of service. These men belong to a stokers mess on a Nelson-class battleship. Rather than cots, the crew slept in hammocks, like the one seen here.

(NCOs), the chief petty officers, petty officers and leading seamen. These men were masters of their trade, whether it be seamanship, gunnery, marine propulsion or electrical engineering. They coached their less-skilled shipmates in their trade, and provided a vital bridge between the officers and the men of the lower deck.

As for the officers, most were members of the Executive Branch, trained in seamanship, gunnery, navigation and leadership. These were the officers who rose to command battleships, or attained flag rank, and who actually supervised the fighting of their ships when they went into action. There were also engineering officers, who looked after a ship's technical aspects, such as propulsion systems or electrical supply, and account officers, who looked after a ship's pay and administration. On battleships, the bulk of these officers – particularly the senior ones – were regular officers, who joined the service before the war. These tended to be highly trained professionals, most of whom, like the long-service men who served under them, had been in uniform since their early teens. These, though, were augmented by a growing number of RNR or even RNVR (Royal Naval Volunteer Reserve) officers, many of whom took time to gain the level of professionalism enjoyed by their regular compatriots.

While the battleships were among the last warships in the fleet to feel the effects of a dilution of the regular navy, by 1941, over half of a battleship's officers came from the RNR or RNVR, and this was reflected by a similar number of HO ratings. Many of these men had never been to sea before they were drafted to their ship. To many regulars, these newcomers lacked discipline and manners, as well as the skill of a professional sailor. By 1943, the regular sailor was a rarity on board a battleship, but for the most part, their wartime replacements had adopted their traditions and values, and were every bit as competent as their predecessors. The war brought with it new technological and skill-set challenges, and these newcomers often adapted themselves to these new ways with more zeal than their potentially hidebound long-service shipmates.

On a battleship, the crew tended to be divided into two watches (named 'Port' and 'Starboard'), although engine-room staff operated a three-watch system. On a King George V-class battleship, with its complement of up to 1,630 men, the stokers were divided into three watches, giving them a routine of standing one watch in every three. The bulk of the crew using the two-watch system were subdivided into six divisions (Quarterdeck, Torpedo, Gunnery, Communications, Top and Forecastle), each of which was responsible for the maintenance of their part of the ship, and for fighting it when the battleship went into action. In addition, there was a group called the Daymen, who held no watches, but maintained something more akin to a daytime working routine. Their number included the medical, administrative and domestic staff on board. Finally, the Royal Marines maintained their own watch system.

ADMIRAL JOHN TOVEY (1885–1971)

'Jack' Tovey was born in Kent, and joined the Royal Navy in 1900. By the start of World War I, he was a lieutenant-commander, and in early 1915, he was given his first command. At the 1916 Battle of Jutland, his destroyer *Onslow* bravely attacked the German cruiser *Wiesbaden*. Tovey won the DSO for this action, and ended the war as a commander. As a specialist in gunnery and torpedo warfare, a series of destroyer flotilla commands and staff appointments followed. In 1932, he was given command of the *Rodney*, a battleship he would lead into action against the *Bismarck* nine years later. Tovey reached flag rank in 1935, and four years later, he became a vice admiral.

When World War II began, he was second-in-command of the Mediterranean Fleet, but in late 1940, he was recalled to Britain, awarded an acting promotion to full admiral, and named as the new Commander-in-Chief of the Home Fleet. Tovey flew his flag in the battleship *Nelson*, but in April 1941, he transferred it to the brand-new *King George V*. Despite his small stature, Tovey was a natural leader, and his confidence was infectious. His subordinates felt inspired by him, although his tenacity often led him into conflict with his superiors, particularly Churchill, who wished to replace him with a more compliant fleet commander. Tovey, though, was the ideal man for the job. He was deeply religious, but enjoyed good food, and was a keen golfer. His biggest virtues, though, were his imperturbable nature, his ability to read the strategic situation and his willingness to take decisive action.

Admiral John Tovey was a reserved and religious man, but he also had a lighter side. As commander-in-chief, he repeatedly clashed with Churchill over naval operations, but his handling of the fleet during the *Bismarck* sortie in May 1941 proved that he had a keen professional grasp of naval strategy.

The day was divided into four-hour watches, running from midday. However, the dog-watch from 1600 to 2000hrs was split into two two-hour watches, to avoid the same group standing the same watches every day. Each watch consisted of a cross-section of the ship's company, so there were always enough skilled officers, NCOs and men to do whatever was needed to operate the ship, and to deal with any emergency. However, the men also had their normal day stations, which is when routine maintenance was carried out on their parts of the ship. During Action Stations, everyone had their place of duty, and so the ship went into battle fully manned and ready for action. Not only did this mean manning the guns and the engines, but it also involved the mustering of Damage Control parties, to deal with fire and flooding, as well as medical staff being on hand to deal with any casualties. The importance of Damage Control was enshrined in the naval priority of 'Float, Move, Fight', in that order.

Above all, a British battleship of this period was not just a floating community, but a large and complicated machine of war. During the Battle of the Denmark Strait, the crew of *Prince of Wales* were thrown into action without being given time to 'shake

ADMIRAL BRUCE FRASER (1888–1981)

Despite being the son of a general, Fraser joined the Royal Navy when he was 12. By 1914, he was a lieutenant, specializing in gunnery. He saw action during the Gallipoli campaign, but was then transferred to the navy's gunnery school, and so missed Jutland, joining a battleship after the battle. He saw more fighting during the Russian Civil War, aiding the Whites of the Caspian Sea Flotilla in 1920 before his capture by the Bolsheviks. He returned to the gunnery school after his release, and in 1924, he became the Chief Gunnery Officer of the Mediterranean Fleet.

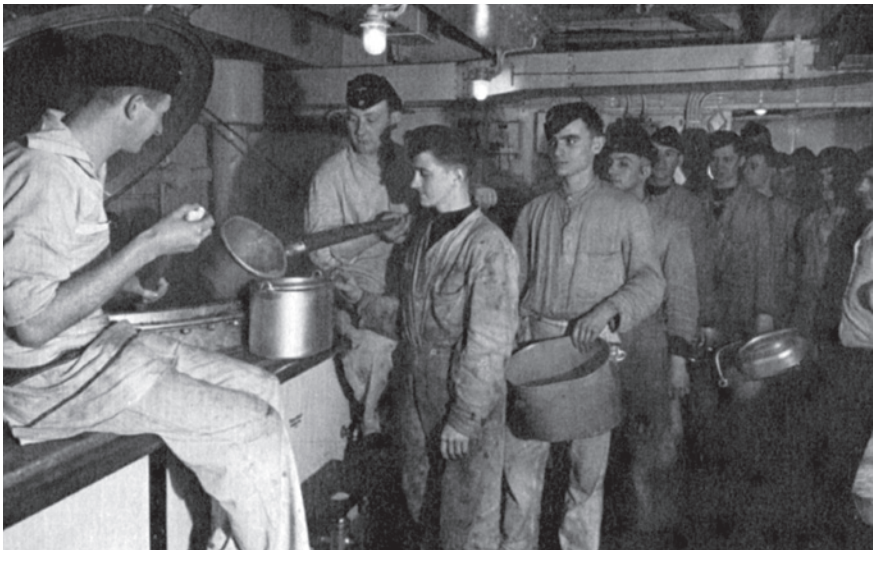
In 1929, Fraser was given command of a cruiser; other commands and staff appointments followed. He attained flag rank in 1938, which led to his appointment as Third Sea Lord. Fraser became a vice admiral in 1940, and was duly appointed as the second-in-command of the Home Fleet. In May 1943, he succeeded Admiral Tovey as the fleet's commander-in-chief, flying his flag in the battleship *Duke of York*. His primary job was the protection of the Arctic convoys, a task he performed with skill and enterprise. Fraser was a keen advocate of radar-directed gunnery, and made sure his ships used this advantage to the full. It was Fraser who masterminded the stalking of the German battleship *Scharnhorst*, and her destruction owed much to Fraser's thorough understanding of this new technology.

Admiral Bruce Fraser was an expert in naval gunnery, and had a reputation as a thinking admiral. Certainly, his planning of the ambush and destruction of *Scharnhorst* revealed a keen grasp of both operational matters, and the technology of modern naval warfare.

themselves down' into an efficient ship's company. Like their ship itself, which underwent significant 'teething troubles' during its first action, these men often lacked the professional reliability that comes with experience and practice. However, after the action, their captain complimented their performance, and declared he was proud of them. With this kind of encouragement, and ideally with more time to gain experience of their ship and their new life, the crew of a battleship would eventually merge into a highly efficient and professional team. This was certainly the case on board the *Duke of York* in late 1943, as when the battleship went into action, her crew performed like a well-oiled machine.

GERMAN BATTLESHIP CREWS

In 1939, the Kriegsmarine had around 50,000 men in its ranks. Many of these sailors had served in the Reichsmarine, until the German navy underwent its change of name in 1935. In the peacetime Reichsmarine and Kriegsmarine, a sailor volunteered for 12 years' service. This total increased dramatically during the war, until by 1943, the



Like their British counterparts, the crew of a German battleship collected their food from a central galley, and then took it down to the messdecks to eat. Just as the British did, representatives of each messdeck collected the food for their shipmates.

Kriegsmarine had a strength of over 630,000 men. However, most of these served in shore-based units, such as coastal artillery or flak batteries, in radar, command, or communications centres, or in naval supply bases, dockyards and training schools. Some of these men, particularly the officers and senior non-commissioned officers, had served during much of the interwar period, and some had even seen action during World War I. The majority, though, were relatively new recruits, and in many cases, the battleship they were drafted to was their first ship. The average age of a sailor on board *Scharnhorst*, *Gneisenau*, *Bismarck* or *Tirpitz* was just 23.

In the Reichsmarine, naval recruits received their initial training in shore bases, attached to either the Ostsee (Baltic) or Nordsee (North Sea) districts, based respectively in Kiel and Wilhelmshaven. Within these districts, further training centres were established in other nearby locations, such as Stralsund for the Ostsee department and Groningen for the Nordsee. Other more specialist training schools were created, too, housing marine propulsion, gunnery, electrics and torpedo warfare. Some of the most skilled recruits were selected for training as *Maate* (petty officers), and so received additional pre-ship training in a *Marineunteroffizierabteilung* (Naval Non-Commissioned Officer Company). Again, each department had their own NCO school, based in Kiel, Stralsund and Wesermünde, the latter serving the Nordsee division.

A *Matrosen-Obergefreiter* (leading seaman), who supervised a squad-sized group of these young sailors, was usually an experienced hand, who had served in the peacetime navy, and who was a specialist in his own field. However, he lacked the advanced specialist training of the *Unteroffiziere* (NCOs) – the *Maate* or *Obermaate* (chief petty officers). So, unlike in the Royal Navy, these ranks tended to be more technical in nature – akin to the British artificer – and linked directly to a specialism, such as gunnery, ordnance, machinery, torpedoes or signals. A *Maschinenmaat* was an engineering petty officer. One problem the Kriegsmarine had was that until 1935, there was no pool of suitably trained reservists. Many of these *Unteroffiziere* lacked the length of service or pre-war experience of their British counterparts. As the war

The carrying of stores on board a Bismarck-class battleship. Both British and German battleships had large storerooms for dry goods and liquids, as well as refrigerated stores where frozen meat was kept.

progressed, the supply of suitably experienced petty officers became a problem. Consequently, greater emphasis was placed on shore-based training, before deployment.

While the Royal Navy was large enough to permit a fairly regular rotation of manpower, in the Kriegsmarine more emphasis was placed on service within a particular ship. When *Bismarck* was commissioned in August 1940, the crew who took her to sea were also those who carried out her sea trials, and who then developed their understanding of their ship and their own duties through extensive on-board training. In the case of *Bismarck* and *Tirpitz*, this took place during the war, and so it was carried out in the Baltic, beyond the reach of British bombers. In the case of *Gneisenau* and *Scharnhorst*, the Kriegsmarine had the luxury of conducting this training during peacetime, with largely peacetime complements. *Gneisenau* spent much of her working-up period in the Atlantic, which gave her crew ocean-going experience. *Scharnhorst* had a shorter period of working up in the Atlantic, before returning to Kiel and Wilhelmshaven for modifications.

While there was some rotation of crew, particularly when a battleship underwent an extensive period of repairs or refitting, such as *Scharnhorst* and *Gneisenau* did in 1941, the tendency was to avoid the large-scale rotation of personnel. There was a steady trickle of replacements, though, when men were promoted and transferred elsewhere, or moved off the ship for health or disciplinary reasons. For the most part, though, the company of a Kriegsmarine battleship tended to remain together throughout the war – far more so than their British counterparts.

ADMIRAL GÜNTHER LÜTJENS (1889–1941)

A Hessian from Wiesbaden, Lütjens joined the Imperial German Navy in 1907, and eventually specialized in torpedo warfare. For much of World War I, he served in torpedo-boat flotillas in the North Sea and the English Channel, rising to the rank of *Kapitänleutnant*, and the command of a half-flotilla. In May 1917, he fought a couple of spirited actions against Allied destroyers, and was duly awarded the Iron Cross (*Eisernes Kreuz*).

After the war, Lütjens served in the Reichsmarine, and during the 1920s, he filled a number of staff, training and command posts. In 1933, he became a *Kapitän zur See*, and was given command of the cruiser *Karlsruhe*. In 1937, Lütjens reached flag rank, and as a *Konteradmiral* he commanded the destroyer force of what by then had been renamed the Kriegsmarine.

Following the outbreak of World War II, Lütjens commanded Germany's scouting forces in operations in both the Baltic and the North Sea, and was duly promoted to *Vizeadmiral*. During the German invasion of Norway, he commanded the *Scharnhorst* and *Gneisenau*, his two battleships seeing action against the British battlecruiser *Renown*. This experience made Lütjens the ideal candidate to command the same ships on their next sortie into the North Atlantic. In June 1940, he became one of the Kriegsmarine's select group of fleet commanders (*Flottenchef*), charged with leading major surface operations. In this capacity, he was in operational command of both Operation *Berlin* and Operation *Rheinübung*, flying his flag in *Gneisenau* and *Bismarck* respectively. He died in action when the *Bismarck* was sunk on 27 May 1941.

Lütjens was a brave, determined and skilled commander, and to many he appeared taciturn. He was staunchly opposed to the politicization of the Kriegsmarine, and when he met Hitler, he pointedly greeted him with the naval salute rather than the Nazi one. He was probably the best tactical commander in the German Navy, and his strategic abilities were ably demonstrated during his two Atlantic forays. In the end, though, his pessimism may well have contributed to the defeatist attitude on board the *Bismarck* during her final hours.

Admiral Günther Lütjens had the unenviable task of breaking through the British patrol lines to reach the vastness of the North Atlantic. He did this successfully with *Gneisenau* and *Scharnhorst*, but despite initial success, his luck ran out when he attempted to do the same with *Bismarck* and *Prinz Eugen*.

Kriegsmarine officers went through a similar recruitment and selection system to the ship's company. From 1936 onwards, officer recruits had to swear an oath to the Führer Adolf Hitler, although the Kriegsmarine's high command otherwise resisted the Nazification of its officer corps. Training was carried out at Danholm, followed by a cruise on a sail training ship. Ideally, this was followed by an ocean-going deployment

KONTERADMIRAL ERICH BEY (1898–1943)

Born in Hamburg, and schooled in a naval academy, Bey joined the Imperial German Navy in 1916. He served in cruisers and torpedo boats during World War I, ending the conflict with the rank of *Leutnant zur See*. During the Weimar Republic years, Bey filled a range of training, staff and seagoing posts in the Reichsmarine, and by 1935, he had reached the rank of *Korvettenkapitän*. By then, he was an experienced torpedo specialist, and during the last years of peace, his postings centred around the Kriegsmarine's destroyer force.

By the outbreak of World War II, he was a *Kapitän zur See*, and the commander of the 4.Zerstörer-Flottille (4th Destroyer Flotilla). During the invasion of Norway in 1940, he commanded the flotilla in action, and distinguished himself in the naval battles fought around Narvik. For his courage, Bey was awarded the Knight's Cross (*Ritterkreuz*), and given command of the 6.Zerstörer-Flottille (6th Destroyer Flotilla). He was also placed in charge of what remained of the fleet's destroyers. In this capacity, he distinguished himself again during the Channel Dash of February 1942. By then, the bulk of the navy's surviving destroyers had been moved to Norway, and Bey supervised their use in support of the Kriegsmarine's larger warships in the region. He reached flag rank in March 1943. Finally, in November 1943, he was named as the new commander of the Kriegsmarine's battlegroup in Norway, flying his flag in the battleship *Scharnhorst*. It was Bey who took *Scharnhorst* to sea the following month, and he was lost when *Scharnhorst* was sunk off North Cape on 26 December 1943.

Bey was an experienced and highly competent naval officer, and his experience of destroyer operations made him an excellent choice for his main wartime role, commanding these lighter forces. However, he had no real experience commanding larger warships. His lack of familiarity with battleships and the importance of radar may well have contributed to the battleship's loss.

Konteradmiral Erich Bey was a destroyer commander at heart, and never appeared comfortable commanding a capital ship. In December 1943, he was ordered to sortie with *Scharnhorst* without being given adequate time to prepare for the operation.

on a cruiser, which served as a training ship. Those who passed this acquaintance with the navy were sent to the naval academy at Flensburg, where they were schooled in their craft. Further training was then provided in a specialization, such as gunnery, torpedoes or engineering. After the dramatic expansion of the navy in 1939, the ratio of officers to men fell sharply, until by 1943 it was 1:30 – roughly half of the pre-war ratio. This placed a greater emphasis on the Kriegsmarine officer as a leader, and as a decision-maker.

At sea, the crew of a German battleship was divided into watches, using the same two-watch system as the Royal Navy, with a three-watch system for engineers. For example, on *Bismarck* the regular crew of 2,065 officers and men were divided into 12 divisions, each consisting of 150–200 men. These were based around a speciality. Four

On a quayside, the brass band of the battleship *Tirpitz* perform a surprise concert on the occasion of their captain's birthday. Both British and German battleships had a contingent of bandsmen, mainly for ceremonial occasions.

of these were seamen's divisions (which included the main and secondary gun crews), two were for the anti-aircraft crews, three were filled by the engineering ratings, while the last two were made up of Daymen (cooks, stewards and sickbay attendants) and gunnery artificers. Each division was divided into Red or Green watches (the equivalent of the British Port and Starboard watches), then subdivided again into smaller units. These divisions served as administrative units, as well as for welfare and discipline purposes, but they also contained their own training and advancement structure, within their own specialism.

There were several similarities in the way the Kriegsmarine and the Royal Navy organized their ships' companies, and in the way their crews were administered. In both navies, a lot of reliance was placed on the non-commissioned officers to maintain professional standards, and to ensure the men were suitably trained and ready. This was particularly important given the challenging technical nature of these ships, especially when it came to their complex fire control and gunnery systems, and their propulsion. While officers were expected to take the lead and make the key decisions, in both navies it was the non-commissioned officers who made sure these orders were carried out quickly and professionally. Two things separated the two navies, though. The first was the way that German battleship crews underwent considerable on-board training before their ships were released on active service. The second was that German battleship crews tended to be kept together, and so officers and men knew each others' capabilities, and those of their ship.

COMBAT

OPERATION *RHEINÜBUNG*, 18–27 MAY 1941

THE BATTLE OF THE DENMARK STRAIT

The premise of Operation *Rheinübung* was that *Bismarck* and the heavy cruiser *Prinz Eugen* would break out into the North Atlantic, and repeat the success of Operation *Berlin* by preying on Allied convoys. As before, Admiral Lütjens was in charge of the operation, flying his flag in *Bismarck*. *Prinz Eugen* sailed on 18 May 1941 from Gotenhafen (Gdynia), followed on 19 May by *Bismarck*.

Bismarck, pictured from her consort the heavy cruiser *Prinz Eugen*, during the Battle of the Denmark Strait (24 May 1941). Due to the intensity of the muzzle flashes from her 38cm guns, the negative was underexposed, and so it appears as if *Bismarck* is firing at night.

HMS *Prince of Wales*, pictured at anchor in Scapa Flow, a week after she was commissioned into service. At the time, civilian ordnance technicians were still working on her, to deal with the numerous problems experienced with her main gun battery. They were still on board when she sailed out of Scapa to take on *Bismarck*.

Lütjens realized that, first, he had to pass through the screen of British cruisers patrolling the three main passages into the Atlantic: between Greenland and Iceland, then Iceland and the Faeroes, and finally between there and Shetland. He opted for the first of these – the passage known as the Denmark Strait. When his force entered the strait on the evening of 23 May, he encountered the British heavy cruisers *Norfolk* and *Suffolk*, who shadowed the German ships as they headed south, sending a series of sighting reports to Admiral Tovey, commanding the British Home Fleet. Lütjens, though, was unaware that Tovey had second-guessed him, and had already dispatched two capital ships to seal off the southern end of the strait.

These were the battlecruiser *Hood* and the brand-new battleship *Prince of Wales*. This force was commanded by Vice Admiral Lancelot Holland, who flew his flag in *Hood*. Thanks to the cruisers' sighting reports, Holland was able to control the time of the clash – an engagement that went down in history as the Battle of the Denmark Strait. At 0537hrs, lookouts on *Hood* spotted smoke to the north. At the time, *Hood* and *Prince of Wales* were steaming in line astern towards the east-south-east, with the flagship leading. At this point, the two pairs of warships were 30,000yds (15 miles) apart, and steering courses that were virtually at right angles to each other. Holland hoped to 'cross the T' of the German force, where all of his guns could fire at the enemy, while only their forward guns could fire back. Both the eight 15in. guns of *Hood* and the ten 14in. guns of *Prince of Wales* had a maximum practical range of around 25,000yds (12.5 miles), so Holland intended to close the range before opening fire.

There were other considerations, too. *Prince of Wales* had mechanical problems with her turrets, which hindered the battleship's combat effectiveness. Civilian technicians

were still on board her, trying to iron out these teething problems. Just as importantly, *Hood* lacked adequate deck armour, and at ranges over 18,000yds (8.9 miles), shells had a high arc of fire, and so tended to fall almost vertically onto their target. This increased the chances of hits on the battlecruiser's vulnerable deck, rather than her better-protected armoured belt. Holland decided to close the range as quickly as he could, and ordered a 40° turn to starboard, so that his ships were heading almost directly towards the enemy, towards the east-north-east. By contrast, Lütjens altered slightly to starboard, so he was steering towards the south-west. If this continued, it would be Holland whose 'T' would be crossed, not Lütjens'.

By 0552hrs, the range was down to 25,000yds (12.5 miles). At this stage, the British had ten large-calibre guns pointing at the enemy, as opposed to the eight on *Bismarck*. *Prinz Eugen*'s eight 8in. guns would be little more than an irritant in the fight that followed. *Hood* opened fire with her two forward turrets, followed by *Prince of Wales* with hers. By then, Captain John 'Jack' Leach of *Prince of Wales* had altered course slightly, so the two British ships were approaching the Germans in echelon, with the battleship a little to starboard and astern of the battlecruiser. On the German side, *Prinz Eugen* was ahead of *Bismarck*, with the battleship following astern of the cruiser. Holland presumed the leading enemy ship was *Bismarck*, and ordered both of his ships to fire on her. However, the gunnery officer of *Prince of Wales* realized the *Bismarck* was astern of the cruiser, and so Captain Leach ignored orders and targeted her instead. It took *Hood*'s gunnery team several vital minutes before they realized their mistake. By that time, it was too late.

At that range, it took 44 seconds for the salvos to reach their targets. *Prince of Wales*' first salvo landed a mile astern of *Bismarck*, while *Hood*'s one hit the water half a mile short of *Prinz Eugen*. However, that first salvo caused a gun in 'A' turret of *Prince of Wales* to malfunction. At 0555hrs, Lütjens finally gave the order to open fire. The range was just over 22,000yds (11 miles), and the enemy could now be seen by the naked eye. Both German ships targeted the *Hood*, leaving the *Prince of Wales* alone – for the moment. *Bismarck*'s opening salvo fell a little short and to the right. Meanwhile, the British ships continued to fire, and the gunnery teams corrected their aim.

On *Prince of Wales*, the malfunctioning gun was briefly repaired, and joined in the firing of the battleship's fifth salvo, but it immediately broke down again, and stayed out of action for the rest of the battle. At 0556hrs, a 14in. shell from *Prince of Wales*' sixth salvo struck the port side of the German battleship, beneath her fo'c's'le. The shell penetrated the largely unarmoured bow of the battleship, and passed through it to exit on her starboard side. This caused flooding and an oil leak. The range at this stage was down to 19,340yds (9.7 miles). Three minutes later, the British ships turned slightly to port, on Holland's orders, as he wanted to 'clear his after arcs' and bring his after turrets into action. A minute later, *Prince of Wales* scored another hit on *Bismarck*, striking her amidships, below the waterline, beneath her main armoured belt. This caused minor flooding in an electrical plant room and another oil leak. The hit annoyed Lütjens sufficiently to order *Prinz Eugen* to switch her fire to the British battleship. So, the cruiser's seventh salvo was directed at *Prince of Wales*.

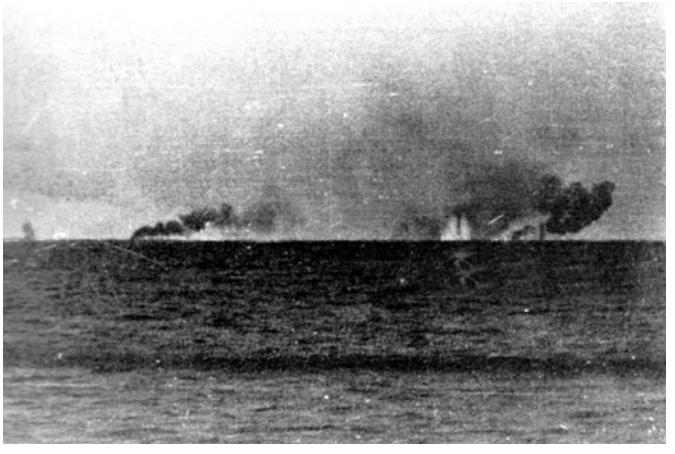
By 0559hrs, *Hood* had fired ten salvos at the German cruiser, without scoring any hits. *Prince of Wales* scored a third hit, causing only light damage amidships as the shell failed to explode. However, while all her turrets could now bear, two of her ten guns

The King George V-class battleship *Prince of Wales*, pictured off Orkney in the summer of 1941, shortly after the damage suffered at the hands of *Bismarck* had been repaired. She and her sister ship *King George V* joined the Home Fleet at a crucial time, when the German surface threat was at its height.

had malfunctioned. Still, from the 13 salvos she had fired at *Bismarck*, she had achieved three hits. Although the German battleship had still to score a hit on *Hood*, her salvos were now on target. So, her gunners fired three salvos in quick succession, each 30 seconds apart. The two British ships were still turning to port when the first of these salvos – the battleship's fourth – fell short, landing right where *Hood* would have been before the turn began. The second, though, landing at 0601hrs, was spot on. One of *Bismarck*'s eight 15in. shells struck *Hood* just astern of her mainmast. The shell plunged through her poorly protected deck, and most probably exploded inside the working space for the battlecruiser's secondary 4in. guns.

The resulting fireball ignited her after 4in. magazine. On the other side of a bulkhead was the magazine holding the propellant charges for the 15in. guns of 'X' turret. When these erupted, the turret was hurled into the air by the blast. On *Prince of Wales*, Captain Leach saw a huge column of orange flame shoot up, and *Hood* was immediately enveloped in smoke. The explosion blew the stern off the ship. On the bridge, a survivor recalled that all they felt was a huge judder, and the ship began listing to port. Then thick brown smoke drifted past. The helmsman reported that the steering had gone, but then the battlecruiser began listing heavily, and it was clear something catastrophic had happened astern of them. On *Bismarck*, the gunnery teams saw the explosion, the flame and the smoke, and realized that the *Hood* had just blown up. A few seconds later, the shock waves from the explosion reached them, even though they were almost 9 miles away from its epicentre.

On *Prince of Wales*, half a mile from *Hood*, Captain Leach ordered an immediate turn to starboard, to avoid colliding with the stricken battlecruiser. As the battleship steamed past and the smoke cleared, they saw the stern of *Hood* rising out of the water, while the front two-thirds of the battlecruiser had been carried on by its own momentum. Then it too began to sink, until only the tip of the bow was left sticking out of the water. That morning, *Hood* had steamed into battle with a crew of 1,421 men on board. There were only three survivors. Now, of course, the odds had changed dramatically. *Prince of Wales* was still very much in the fight, but she was down to eight 14in. guns. On board *Bismarck*, Lütjens ordered Kapitän zur See Ernst Lindemann to target the British battleship, which *Prinz Eugen* was already engaging. *Bismarck*'s next few salvos were directed at *Prince of Wales*, which was now 16,400yds (8.2 miles) away.



This photograph, taken from *Prinz Eugen* at around 0601hrs on 24 May 1941, shows *Prince of Wales* on the left, and *Hood* on the right, during the Battle of the Denmark Strait. Moments later, *Hood* blew up. At the time, *Prince of Wales*, hidden by her funnel smoke, had already hit *Bismarck* with her 14in. guns.

She hit her target with the eighth salvo, moments after *Prince of Wales* had steamed past the sinking remains of *Hood*. A 15in. shell struck the battleship's compass platform (bridge), killing or wounding almost everyone inside it. The shell did not explode, but it temporarily put the British battleship out of action. A minute later, *Bismarck* scored two hits with her ninth salvo. One shell struck *Prince of Wales* on the waterline, without doing any damage, while the other struck the starboard secondary 5.25in.-gun gunnery director, putting it out of action. Some 30 seconds later, she scored a fourth hit, this time on the boat deck, peppering the funnel, wrecking a crane and damaging the battleship's Walrus float plane. *Prinz Eugen* had scored three hits, with one 8in. shell failing to explode beside a port-side secondary ammunition store. While *Prince of Wales* was still firing back, 'Y' turret was now down to one working barrel, as three of its four guns had now malfunctioned.

The bridge hit on *Prince of Wales* had momentarily stunned Captain Leach, but he was still alive. The compass platform resembled a charnel house, but as the wounded were tended, he began to assess the damage. He was now down to just five working guns, and it was clear he was losing the fight. He decided to break off the action, at least for the moment, so he ordered a turn to port, and the laying down of a smokescreen. Thick black oily smoke from the battleship's funnel now began obscuring the *Prince of Wales*, but, of course, the turn also masked her forward guns, leaving her with only one workable 14in. gun that could bear on the *Bismarck*. He contacted the senior officer in the area, Rear Admiral Frederic Wake-Walker on *Suffolk*, and asked permission to break off the fight. Wake-Walker agreed with the decision. The battleship fired a final, single-shell salvo from her after turret at 0605hrs. Lütjens also decided to break off the action, and at 0609hrs, he gave the order to cease fire.

The battle had lasted just 17 minutes. *Bismarck* had performed well, sinking *Hood* with her fifth salvo, and damaging and driving off *Prince of Wales* with five more. *Prince of Wales* had shot well, too, scoring three hits on *Bismarck*, but these only caused relatively minor damage. However, the third hit had struck *Bismarck* below the waterline, causing a leak in her port fuel tank. This, though, together with the severing of a fuel pump by the first hit, had changed everything for Lütjens. He now lacked the fuel reserves he needed to continue his sortie. Even if he linked up with one of the German tankers stationed around the periphery of the North Atlantic, he was still being shadowed by Wake-Walker's two cruisers, and so he would be hard-pressed to refuel, as the Home Fleet would be hunting him. Lütjens decided to head towards a German-occupied port in France, so *Bismarck* could be repaired.

The Battle of the Denmark Strait was a clear German victory, and the loss of *Hood* was a severe blow to the Royal Navy. During the interwar years, this graceful battlecruiser had been something of an icon for the Royal Navy, and her dramatic loss with almost all hands was a huge blow to both national morale and Britain's

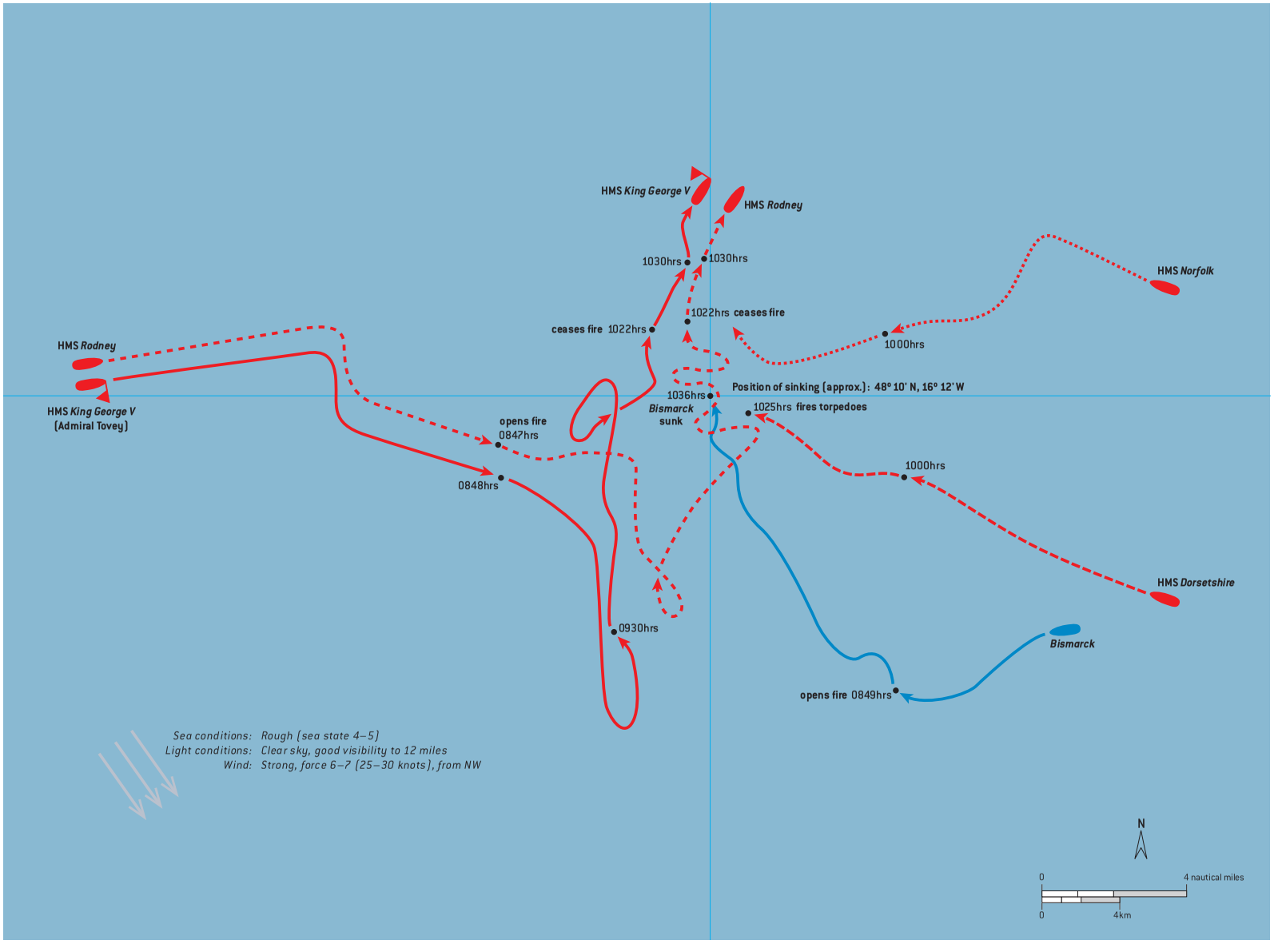
international prestige. However, Admiral Tovey, steaming to intercept *Bismarck* with units of the Home Fleet, was now aware that it was up to him to stop *Bismarck*, and to avenge the crew of the *Hood*. For the next few days, as *Bismarck* headed towards the French coast, Tovey and his Home Fleet did whatever they could to bring her to battle. Meanwhile, *Bismarck* and *Prinz Eugen* had parted company, as the cruiser headed into the Atlantic to hunt on her own. Then, in the early hours of 25 May, Lütjens successfully evaded Wake-Walker's cruisers, and for 30 hours, the British had no idea where *Bismarck* was. She was relocated, though, shortly after 1300hrs on 26 May. Much to Tovey's dismay, *Bismarck* was further east than he had imagined, and out of reach of his two battleships. Now, only a miracle could stop *Bismarck*.

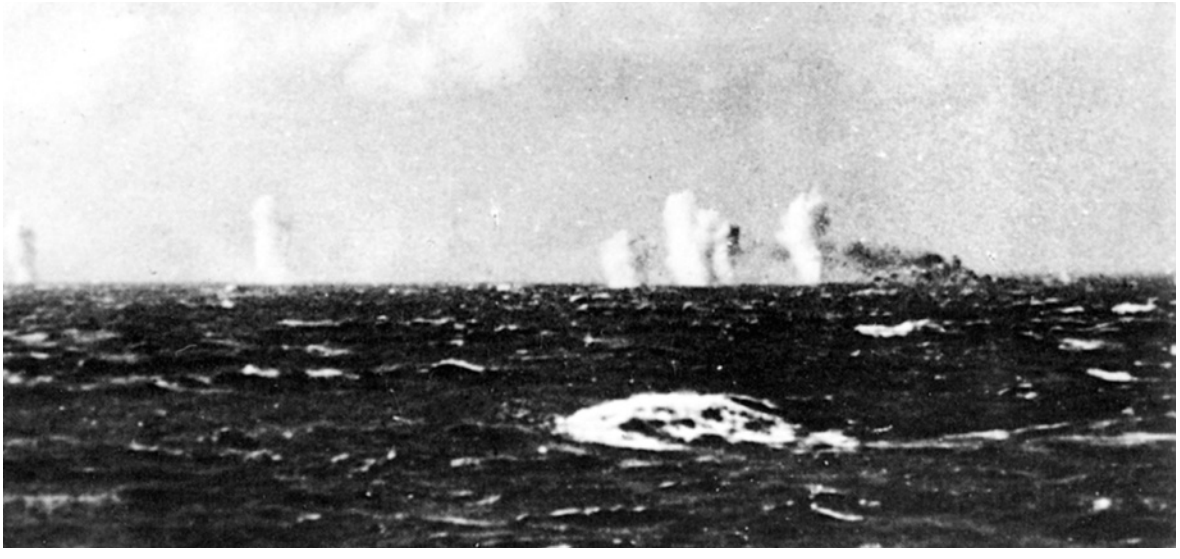
THE SINKING OF THE *BISMARCK*

Having parted company with *Prinz Eugen*, *Bismarck* was now on her own. On the evening of 26 May, 15 Swordfish torpedo-bombers took off from the aircraft carrier *Ark Royal*, to carry out a strike against *Bismarck*. The aircraft began their attack shortly after 2047hrs, targeting the battleship in small groups. She was hit by two torpedoes, but the first of these exploded against her thick armoured belt, and did no damage. The second, though, struck the battleship's stern, damaging a propeller and jamming her rudders. *Bismarck* was turning at the time, and so the battleship began circling to port. Kapitän zur See Lindemann did what he could to counter this using his engines, while repair teams and divers attempted to repair the damage. It proved impossible: *Bismarck* had been crippled. When Admiral Tovey learned of this, he ordered Captain Philip Vian and five destroyers (at the time escorting a troop convoy from Glasgow to the Indian Ocean) to harry the German battleship throughout the night, and to report on her progress.

Meanwhile, Tovey gave orders to the captains of his flagship *King George V* and the accompanying battleship *Rodney* to set a course to intercept *Bismarck* at dawn. As

During the final battle of *Bismarck* on 27 May 1941, *Rodney* inflicted multiple hits on the German battleship with her 16in. guns. While these did not sink *Bismarck*, they destroyed her ability to fight. During the action, *Rodney* also fired torpedoes at *Bismarck*, from her submerged torpedo tubes.


HMS King George V
HMS Rodney
1030hrs
1030hrs
HMS Norfolk
1022hrs ceases fire
ceases fire 1022hrs
1000hrs
HMS Rodney
HMS King George V
(Admiral Tovey)
1036hrs
Position of sinking (approx.): 48° 10' N, 16° 12' W
Bismarck
sunk
1025hrs fires torpedoes
opens fire
0847hrs
1000hrs
0848hrs
HMS Dorsetshire
0930hrs
Bismarck
opens fire 0849hrs
Sea conditions: Rough (sea state 4–5)
Light conditions: Clear sky, good visibility to 12 miles
Wind: Strong, force 6–7 (25–30 knots), from NW
N
0
4 nautical miles
0
4km



One of the final photos of *Bismarck*, taken on 27 May 1941. She is almost hidden amid the spray of falling shells, and the smoke and flame pouring from her hull. This picture was taken from the British heavy cruiser *Dorsetshire*, which was eventually sent in to finish *Bismarck* off with torpedoes.

Bismarck's crew tried but failed to repair their rudders, they fought off Vian's destroyers, who made a string of brave but unsuccessful torpedo attacks. By midnight, all hopes had faded on board the German battleship, and the crew resigned themselves to what they assumed would now be a fight to the death.

Dawn on 27 May revealed a grey, overcast day, with a Force 8 wind from the north-west, and rough seas. At 0843hrs, *Bismarck* was spotted from *King George V*, at a range of just over 25,000yds (12.5 miles). The German ship was steering an erratic course towards the north-west, while the two British ships were approaching her from the west, with *Rodney* on the port side of Tovey's flagship.

The battle began at 0847hrs, when *Rodney* opened fire with her six forward-facing 16in. guns. The firing arc of her third turret was still obscured. *King George V*'s forward turrets opened up a few seconds later. *Bismarck* then returned fire with her own two forward turrets, targeting *Rodney*. However, due to the damaged steering, her gunnery teams were finding it extremely difficult to fire with any accuracy. Still, her second salvo was a near miss, and *Rodney*'s funnel was peppered by shell splinters. By then, both British battleships had turned slightly so that all their turrets could fire. However, *King George V* was experiencing the same technical problems that had plagued her sister ship *Prince of Wales*. At one stage, a four-gun turret was rendered inoperable for several minutes when her traversing mechanism broke down. Individual guns broke down or jammed, and at one stage, the battleship only had two working 14in. guns.

By now, though, the British shells were finding their mark. At 0902hrs, a 16in. shell from *Rodney* struck *Bismarck*'s forward superstructure, and flames were seen to shoot up around her bridge and conning tower. This probably killed or wounded everyone in *Bismarck*'s bridge, including Lütjens and Lindemann. Her main gun director was also knocked out, which severely impaired *Bismarck*'s ability to fight back. After that, the battle became one-sided, as the German battleship was pounded into submission. By 0908hrs, *Bismarck*'s two front turrets had been silenced, as shells from *King George V* and *Rodney* slammed into the forward part of the German ship. Fires

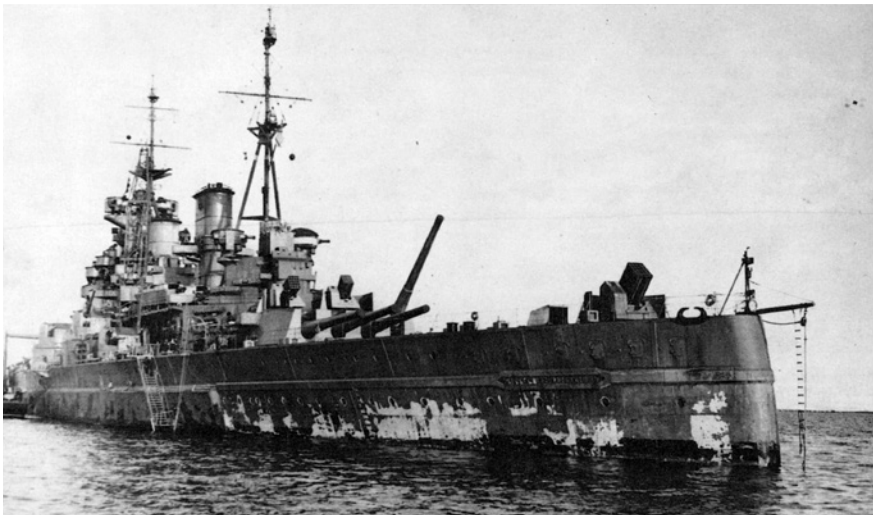
OPPOSITE
The sinking of the *Bismarck*, 27 May 1941

Survivors from *Bismarck* being hauled out of the water by the crew of the British cruiser *Dorsetshire*. Many of these men were badly injured and covered in oil, and were unable to clamber to safety. Of *Bismarck*'s complement of over 2,200, there were only 115 survivors.

were now raging over most of her upper decks forward of the funnel. However, fire control was switched to the after director, and *Bismarck* fought back, firing three ineffectual salvos at *King George V* using her after turrets.

When this director was silenced at 0913hrs, *Bismarck*'s two rear turrets fired under local control before they, too, were put out of action. At 0927hrs, 'Anton' turret briefly re-joined the fight, only to be knocked out by a direct hit a few seconds later. By 0931hrs, *Bismarck*'s guns were silent. The British battleships had closed to within 4,400yds (2.2 miles), and almost every shell was hitting its target. *Bismarck* was battered above the waterline, and fires raged from bow to stern, but she remained afloat. The scene on board was one of horror and carnage, as men were trapped by debris or jammed hatches, or burned to death at their posts. The end was close, but still *Bismarck* refused to sink.

Tovey realized that his battleships had to turn for home immediately, or risk running out of fuel. In desperation, at 0956hrs, *Rodney* even fired two torpedoes at *Bismarck*, from a range of just under 3,000yds (1.5 miles). One of them may have hit,



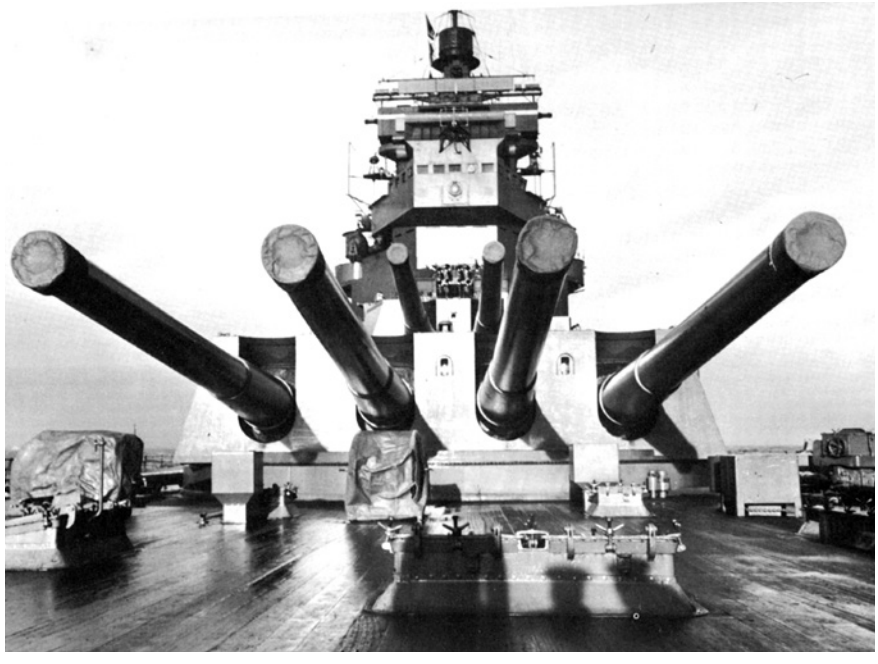
HMS *King George V*, the flagship of the Home Fleet, pictured at her moorings in Scapa Flow a few weeks after participating in the sinking of the *Bismarck*. One of the 14in. guns of 'Y' turret has been raised for maintenance, after malfunctioning during the battle.

making this the only time one battleship torpedoed another one. The British cruisers *Norfolk* and *Dorsetshire* were firing, too, and Swordfish from *Ark Royal* were circling, but unable to launch their own attack without being hit by friendly fire. So, Tovey ordered *Dorsetshire* to close in and finish *Bismarck* off with her torpedoes. At 1016hrs, Tovey ordered his battleships to break off the action, and return to Scapa Flow. During the fight, *Rodney* had fired 380 16in. shells at *Bismarck*, and despite her problems, *King George V* fired 339 14in. ones. Many of these had hit their target.

What finally finished *Bismarck* off is still a matter of some controversy. Shortly after 1000hrs, the battleship's *Erster Offizier* (Executive Officer), Fregattenkapitän Hans Oels, had ordered his men to abandon ship. He also ordered that *Bismarck* be scuttled. Watertight doors were clipped open, seacocks were opened, and at around 1015hrs, a series of scuttling charges were detonated. At almost the same moment, *Dorsetshire* launched two 21in. torpedoes at *Bismarck*: both hit. *Dorsetshire* then circled around *Bismarck*, and fired a third torpedo, which also detonated. Then, *Bismarck* was seen to settle in the water and list to port. At 1039hrs, she capsized and sank, taking most of her crew down with her. Whatever caused this is largely immaterial – the result was still the same. Hundreds more of her crew, though, were left in the water, but for various reasons only a handful of them were rescued. Later, a few more were recovered by German vessels. Of *Bismarck*'s crew of over 2,200 men, there were only 115 survivors. *Hood* and her crew had now been avenged.

OPERATION *OSTFRONT*, 25–26 DECEMBER 1943

From late 1941, the Kriegsmarine posted most of its remaining warships to northern Norway, where they could pose a threat to the Arctic convoys – the vital maritime link between the Western Allies and the Soviet Union. These convoys had to pass close to



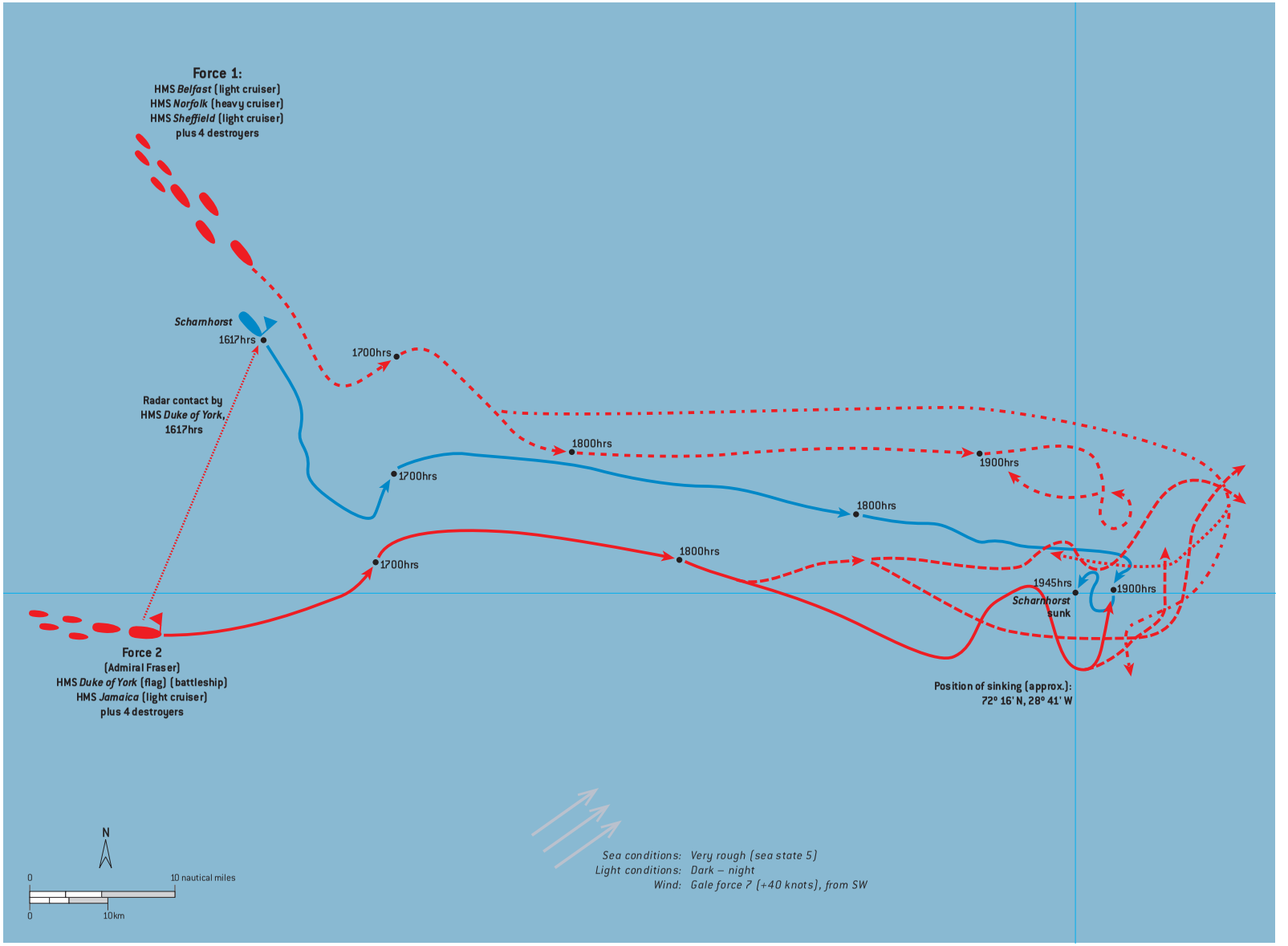
The forward 14in. guns of the King George V-class battleship *Duke of York*, pictured as she lay moored in Scapa Flow during early 1943. These were the guns that pounded the German battleship *Scharnhorst* during the Battle of North Cape.

North Cape, on the northern tip of Norway, on the final leg of their voyage across the Barents Sea to Russia. U-boats and aircraft also used Norway as a base to attack these convoys. However, by late 1943, surface sorties had become less common, as a shortage of fuel and the presence of a reinforced Home Fleet helped to deter German attacks. German losses in the Soviet Union were mounting, and pressure was placed on the Kriegsmarine to do more to interdict these convoys. So, when Luftwaffe reconnaissance reported a new convoy was heading to Murmansk, Konteradmiral Erich Bey, commanding the Arctic battlegroup, was expected to attack it.

Late on Christmas Day, Bey left his base in the Altenfjord in northern Norway with a force consisting of the battleship *Scharnhorst* and five destroyers. This was deemed a powerful enough force to deal with the convoy's close escorts of cruisers and destroyers. If Bey encountered anything more powerful, such as the Home Fleet's distant covering force, he would return to his Norwegian lair. Reports from aircraft and U-boats placed the convoy off Bear Island, so Bey headed north through rough seas and snow squalls. However, Admiral Bruce Fraser, commanding the Home Fleet, had learned of the German sortie, and diverted the convoy northwards, out of harm's way. When Bey reached its expected location, he encountered Force 1, a screen of three British cruisers and four destroyers. A running battle followed, as *Scharnhorst* repeatedly tried to break past the cruisers to reach the convoy. However, *Scharnhorst*'s radar was knocked out during a clash that morning, and so Bey had little chance of fighting his way past his opponents. He decided to break contact and return to the Altenfjord.

Using their radar, Vice Admiral Robert Burnett's Force 1 gave chase, and shadowed *Scharnhorst* as she ran south. They also provided Fraser with sighting reports, so he was able to steer an intercepting course with his distant covering force, which was designated Force 2. The latter consisted of his flagship, the battleship *Duke of York*, accompanied by the light cruiser *Jamaica* and four destroyers. At 1615hrs, the

OPPOSITE
The sinking of the *Scharnhorst*, 26 December 1943


Force 1:
HMS Belfast (light cruiser)
HMS Norfolk (heavy cruiser)
HMS Sheffield (light cruiser)
plus 4 destroyers
Scharnhorst
1617hrs
1700hrs
Radar contact by
HMS Duke of York,
1617hrs
1800hrs
1900hrs
1700hrs
1800hrs
1800hrs
1700hrs
1945hrs
Scharnhorst
sunk
1900hrs
Force 2
(Admiral Fraser)
HMS Duke of York (flag) (battleship)
HMS Jamaica (light cruiser)
plus 4 destroyers
Position of sinking (approx.):
72° 16' N, 28° 41' W
N
0
10 nautical miles
0
10km
Sea conditions: Very rough (sea state 5)
Light conditions: Dark – night
Wind: Gale force 7 (+40 knots), from SW

Admiral Fraser's flagship HMS *Duke of York*, being cheered by the crew of a drifter on her return to her regular mooring in Scapa Flow on New Year's Day 1944, after her victory over the *Scharnhorst* in the Battle of North Cape.

Duke of York detected *Scharnhorst* on her radar, at a range of 22 nautical miles. During the run south, Bey had detached his destroyers, so *Scharnhorst* was now on her own. She was also trapped between Burnett's cruiser *Norfolk*, *Sheffield* and *Belfast* to the north, and *Duke of York* and the cruiser *Jamaica* to the south-west. What was worse for Bey was that he had no idea the enemy were approaching him until 1647hrs. That was when *Belfast* fired four starshells, whose light clearly illuminated the German battleship. She was caught completely by surprise – her main guns were still trained fore and aft.

At that moment, *Duke of York* opened fire with a full salvo of her ten 14in. guns. The range was just under 12,000yds (6 miles). She straddled *Scharnhorst* with her first salvo, and one shell knocked out the German battleship's forward turret. A fire below decks threatened to spread to the magazine of the next turret, 'Bruno', so part of it was flooded to prevent a disaster. So, even before she had a chance to fire back, *Scharnhorst* had lost three of her nine 28cm/52 (11in.) guns. *Jamaica* opened fire, too, with her 6in. guns, and straddled the battleship with her third salvo. The *Duke of York*'s second salvo was a near miss, but she scored a hit with the next one, when a 14in. shell hit the German battleship's after superstructure. It took time for *Scharnhorst*'s crew to react to this unexpected attack. It was 1655hrs before she altered course away from Fraser's flagship. Meanwhile, her gunnery teams raced to get their remaining guns into action.

Now, *Scharnhorst* was racing northwards, towards *Norfolk*, *Sheffield* and *Belfast*, which were 9 miles away. The *Duke of York* and *Jamaica* were 6 miles to the south of *Scharnhorst*, steaming towards the east. The four destroyers of Force 1 were to the west of the cruisers, while those accompanying Force 2 were screening the British battleship. Bey had nowhere to run, but still, he was fighting back. At 1653hrs,

Scharnhorst fired off starshells at *Duke of York*, followed by her first salvo of six 28cm (11in.) shells. The salvo fell short. By now, *Belfast* and *Norfolk* had joined the fight, forcing *Scharnhorst* to retaliate with her secondary armament. At 1700hrs, another 14in. shell struck the *Scharnhorst* amidships. At 1705hrs, another two 14in. shells struck *Scharnhorst* forward of her bridge, temporarily silencing 'Bruno' turret. It was clear Bey was losing the fight, so he ordered Kapitän zur See Fritz Hintze to turn towards the east, in an attempt to evade his pursuers. That, though, would prove impossible.

Scharnhorst appeared to be pulling away from her pursuers, and with visibility so bad, the *Duke of York* was forced to target the enemy using radar. By now, the cruisers had ceased firing, so it was up to the British battleship to bring her rival to bay. Both ships fired several salvos at each other, but by 1800hrs, the German ship had pulled out of radar range. Still, both sides kept firing at each other for another 20 minutes. It looked as if *Scharnhorst* might escape after all. Then, at 1820hrs, the *Duke of York* achieved another straddle, and a shell penetrated the German battleship's armoured belt, and damaged her starboard boiler room. *Scharnhorst*'s speed dropped to 22kts, which allowed the British to catch up. The destroyers were in the lead, and at 1852hrs, *Scorpion* and *Stord* launched 16 torpedoes between them, and scored a hit. *Savage* and *Saumarez* launched 12 torpedoes a minute later, of which three hit their target. *Scharnhorst* was in serious trouble now, with her engines damaged again, and extensive flooding below the waterline.

Then, *Duke of York* fired again, at a range of 10,000yds (5 miles), and scored a direct hit with her first salvo. It may well have knocked out 'Caesar' turret. For another 25 minutes, she pounded the German battlecruiser, which was now unable to reply. The shells hit their target on a flat trajectory, and while few (if any) pierced her armoured belt, they did untold damage everywhere else. Fires were now raging all along *Scharnhorst*'s decks, and her superstructure had been pounded into scrap. It was now clear that gunfire alone would not finish the job, so Fraser ordered the cruisers to use their torpedoes. Both *Jamaica* and *Belfast* missed with their torpedo salvos, so it was left to Force 1's destroyers to strike the final blow. Shortly after 1930hrs, five torpedoes struck *Scharnhorst*, and the German battleship began listing to starboard. *Jamaica* fired another torpedo salvo into *Scharnhorst*'s exposed port-side lower hull. With that, *Scharnhorst* rolled over and began to sink.

It was 1945hrs when the battleship finally disappeared, leaving a pitifully low number of survivors in the water. In those rough seas and freezing waters, they did not stand much of a chance, but in the end, 36 of her complement of 1,968 were plucked from the water by the destroyers *Scorpion* and *Matchless*. This engagement, which became known as the Battle of North Cape, was a single victory for the Home Fleet. It was won primarily by a combination of highly professional gunnery, and some daring torpedo attacks. However, the real arbiter of victory was radar. If the Seetakt set fitted in *Scharnhorst* had worked, the German battleship might not have been taken by surprise. Still, this set was no match for the radar suite on *Duke of York*. Her Type 273Q surface-search radar picked up *Scharnhorst* 22 miles away, while her Type 284 (Mark III) fire control radars gave the battleship the ability to fire her 14in. guns accurately at a target that was completely hidden by the Arctic darkness.

OVERLEAF

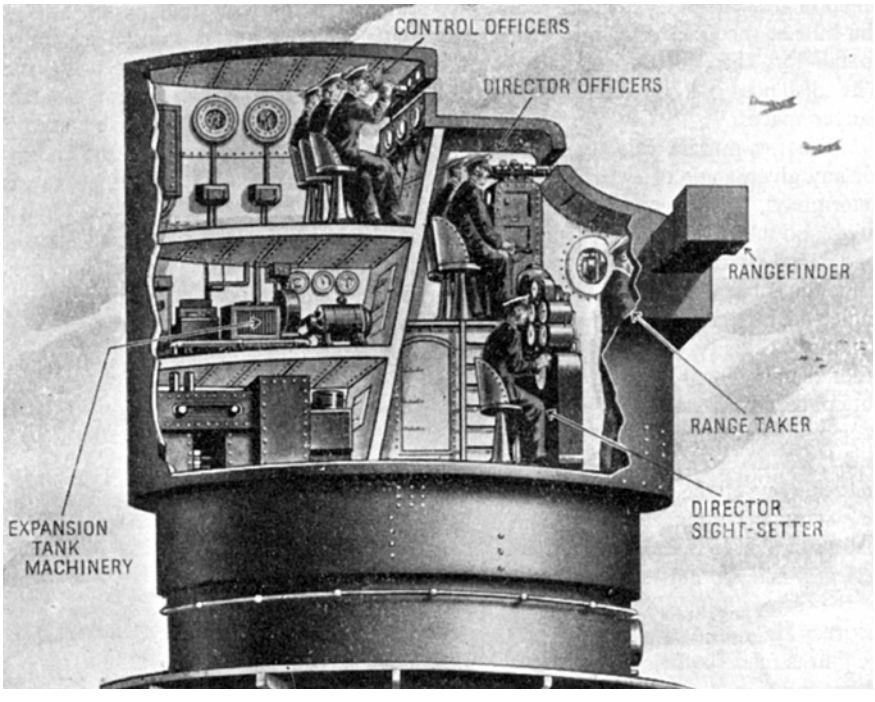
HMS *Duke of York* at the Battle of North Cape, 26 December 1943. Having detected *Scharnhorst* by radar, Admiral Fraser's flagship *Duke of York* closed the range. At 1647hrs, a starshell illuminated the target, and four minutes later, the British battleship fired her first salvo, at a range of just 6 miles. *Scharnhorst* was hit, and further shells struck the German battleship as she turned away. *Scharnhorst* began firing back, and her third salvo straddled the *Duke of York*, as their target was illuminated by starshells. The advantage, though, lay with the British, as thanks to the dark night, rough seas and poor visibility, the German gunners had problems ranging in on their target. By contrast, *Duke of York*'s gunners could rely on their fire control radar to accurately target their German opponent. After an uneven duel lasting some three hours, *Scharnhorst* was battered into submission, and then finished off with torpedoes.

ANALYSIS

For armchair admirals, it might be easy to work out the likely victor in any duel between British and German battleships during this period. You can quantify the ballistic power of these battleships' main armament, and the velocity of their shells. You can build in the capability of their opponents' protective armour, and the velocity and penetrative abilities of the shells. You can even quantify the ability of a ship to withstand damage, and to deal with it in terms of damage control. All this, though, does not take into account other less quantifiable factors. These could be as complex as the strategic or tactical situation, or the weather conditions, or as simple as crew morale – or the fact that some small but crucial piece of equipment malfunctioned at a key moment, or was knocked out in an earlier encounter, as happened to *Scharnhorst*'s radar in December 1943.

Despite their immense power, all four classes of battleship described in this work had their vulnerabilities, and four of them were sunk in action. Granted, two of these were sunk at the hands of enemy aircraft, but the key point is that if these weaknesses could be exploited, even as a result of a lucky hit, then the likely odds in the battleship duel were changed as certainly as if a racehorse favoured to win the Derby pulled a leg muscle. This said, we can offer some general pointers towards the likely performance of these ships in any naval clash. We also have the empirical evidence of three of these clashes themselves, between *Prince of Wales* and *Bismarck*, then *Bismarck*'s last fight against *Rodney* and *King George V*, and finally the clash between *Duke of York* and *Scharnhorst*. We can see how a battleship's theoretical performance worked out in reality.

In the Battle of the Denmark Strait on 24 May 1941, *Bismarck* fired 14 salvos: six at *Hood* and eight at *Prince of Wales*. The first four of those directed at *Prince of Wales* were full eight-gun salvos, fired at ranges of between 14,982 and

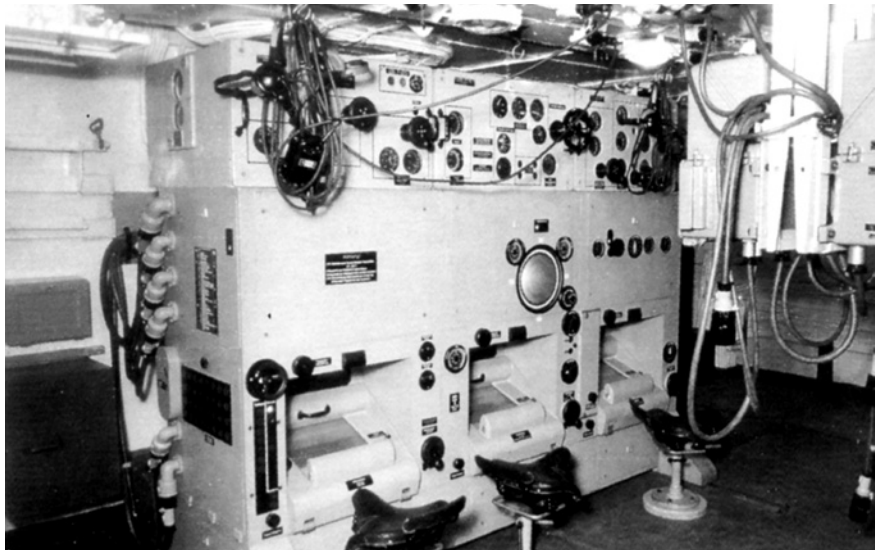


A wartime illustration showing the internal layout of the Director Control Tower (DCT) of a Nelson-class battleship. Inside it, the director team provided visual targeting information to the plotting room, and the gunnery control team controlled the salvo firing of the battleship's main guns.

18,263yds (7.5–9.1 miles), based on the information entered in *Bismarck*'s fire control system. For the last four salvos, *Prince of Wales* was actively pulling away from *Bismarck*, and the last salvo fired at 0609hrs was fired at a range of 24,934yds (12.5 miles). Of these, *Bismarck* hit *Prince of Wales* with her eighth salvo (fired at 0602hrs), twice with her ninth salvo (0603hrs) and with the tenth salvo (0604hrs). After that, the British battleship was turning around and making smoke, which made it increasingly difficult for the German rangefinders to accurately adjust the range.

The hit at 0602hrs struck *Prince of Wales*' compass platform or bridge, causing extensive damage. The two at 0603hrs struck her, first, starboard hull amidships, just above the waterline (the shell did not explode); and, second, on her secondary gun director, on the after part of *Prince of Wales*' forward superstructure. *Bismarck*'s final hit, at 0604hrs, struck the British battleship at the base of her funnel, starting a fire, wrecking the float plane, peppering the funnel and causing minor damage. In reply, *Prince of Wales* fired 14 salvos at *Bismarck*, between 0553hrs and 0601hrs, when *Hood* blew up. During this time, the range dropped from 26,500yds (13.25 miles) to 15,300yds (7.65 miles). While *Hood* failed to score any hits on *Bismarck* or *Prinz Eugen*, the *Prince of Wales*' gunnery team scored one with their sixth salvo. This was impressive shooting.

In fact, the British battleship hit *Bismarck* three times. At 0556hrs, a 14in. shell struck the battleship's port side above the waterline, beneath the fo'c's'le. It penetrated the lightly armoured bow of *Bismarck*, and passed through her starboard side. This hit caused flooding in compartments XX and XXI, and started an oil leak. Nobody knew it at the time, but this hit would bring Operation *Rheinübung* to a premature end due to the reduction in the German battleship's fuel supply. However, good though the



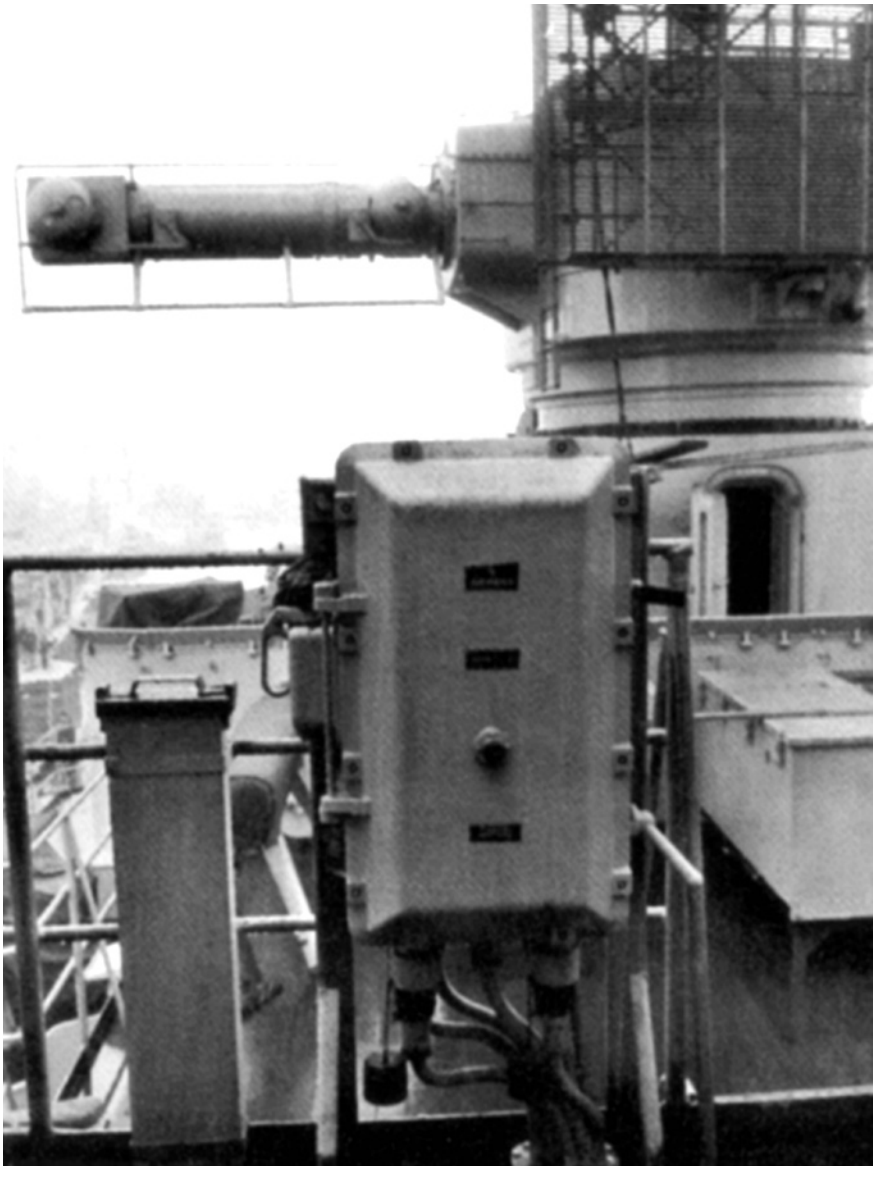
Part of the Hazemeyer C/38 fire control equipment fitted into the gunnery plotting room of the German battleship *Bismarck*. This highly sophisticated analogue computer was built by Siemens, and was supported by other machines in the same room, which constantly updated the gunnery solutions supplied to the battleship's main guns.

Prince of Wales' gunnery was, thanks in part to her AFCT and modern rangefinders, the performance of *Bismarck* during this short action was even more impressive. At 0557hrs, she hit *Hood* with her third salvo, destroying the battlecruiser's DCT, and killing or injuring its crew. It was her sixth salvo though that inflicted the mortal blow to the *Hood*. Then, after turning her guns on *Prince of Wales*, she hit her with only her second salvo at this new target.

Examining the performance of *Bismarck*, *Rodney* and *Prince of Wales* during their battle three days later is more problematic. First, while *Bismarck*'s firepower and gunnery direction systems were as potent as they ever were, the rudder damage she suffered the previous evening meant that it was impossible to steer a steady course. This steadiness was vital to the efficient working of a battleship's gunnery calculations. To make its calculations, *Bismarck*'s Hazemeyer C/38 fire control computer relied on the input of the course, speed and bearing of both firing ship and target. As *Bismarck*'s course was erratic, this rendered these calculations nigh-on impossible. Still, with her second 38cm salvo, fired at *Rodney* at 0850hrs, a shell landed within 20yds of the British battleship. That, though, was as good as it got that morning.

In fact, the damage inflicted on *Rodney* was of her own making. The repeated firing of her 16in. guns created concussive waves that caused bolts and rivets to pop loose, pipes and beams to crack and light fittings to shatter. The venerable battleship was getting too old for this kind of rough treatment. Still, she opened fire at 0847hrs, and maintained a near-continuous fire on *Bismarck* until 1016hrs. By the end, she had closed to within 2,750yds (1.38 miles), and shells were seen to penetrate the German battleship's armoured belt, albeit below the waterline. Although penetrating hits to the *Bismarck*'s citadel were rare, the upper deck and the decks immediately below it were turned into a charnel house, filled with fire, bodies and twisted metal. Effectively, despite the strength of *Bismarck*'s armour, her ability to fight and survive was taken away by multiple 16in. shell hits to her turrets, upper decks and superstructure.

Having knocked out *Bismarck*'s main and after gunnery directors, the German turrets that remained in operation were forced to fire under local control – in other words, without the benefit of the battleship's fire control system. These, too, were soon knocked out, leaving *Bismarck* defenceless. At one stage, *Rodney* even unleashed torpedoes at her target, and one of them may have hit her, a potential first of naval history, where one battleship torpedoed another. For her part, *King George V* also contributed to the destruction of *Bismarck*, opening fire shortly after *Rodney*, and scoring multiple hits. This was despite suffering the malfunctions that had also plagued *Prince of Wales* three days before. 'A' turret suffered a mechanical breakdown that took almost 30 minutes to fix. During this, 'Y' turret also broke down, leaving *King George V* with just two functioning 14in. guns – the ones in 'B' turret.



The starboard arm of one of *Bismarck*'s two 10.5m optical rangefinders. This was the after one, mounted on top of the battleship's after gunnery director tower. Attached to it is the 'bedstead' aerial of the FuMO 27 radar.

It is interesting to compare this performance with that of the *Duke of York* at the Battle of North Cape. *Duke of York*'s search radar detected *Scharnhorst* at a range of 23 miles, while remaining undetected herself. At 1647hrs, when *Scharnhorst* was illuminated by starshells, the range had fallen to 12,000yds (6 miles). The German battleship had been caught completely unawares. The *Duke of York* fired her first salvo four minutes later. The British guns achieved a straddle with this first salvo, and a hit was scored on 'Anton' turret, putting it out of action. She hit her again with her third salvo, as a shell landed on *Scharnhorst*'s after superstructure, starting a serious fire. By then, *Scharnhorst* had turned away from her tormentor, and had begun to increase the range. She was hit again amidships a minute later. It was clear by now that the *Duke of York*'s 14in. guns were firing well, and without any trace of the malfunctions that had plagued her sister ships earlier in the war.

By 1820hrs, the range had increased to 19,000yds (9.5 miles), and in the poor visibility, *Duke of York* was now firing purely using radar fire control, using her Type 284. This proved accurate, though, despite the long range for the system, and after half an hour of fruitless firing, two shells hit *Scharnhorst*. One of them, landing behind the funnel, exploded in a machinery space, and damaged a boiler. This allowed the *Duke of York* to overhaul her opponent. By 1900hrs, *Duke of York* was able to clear her arcs and fire all of her guns at *Scharnhorst*, at a range of just 10,400yds (5.2 miles); these scored penetrating hits. Over the next 20 minutes, *Scharnhorst* was pounded into a floating wreck by multiple 14in. shell hits. In contrast, *Scharnhorst*'s gunners achieved very little. Having been reduced to six guns in two turrets, the German battleship fired her first salvo at 1653hrs, assisted by starshells. However, no hits were scored, apart from a glancing blow to the foremast that knocked out the air-search radar.

The technological advantage the Royal Navy enjoyed over the Kriegsmarine in terms of radar performance became greater as the war progressed, as search radar was augmented by fire control arrays. Here, a radar team operates a search radar plot.

The poor visibility and darkness hindered the German gunnery, and while the ship's Seetakt radar might have helped, this had been damaged earlier in the day. By contrast, the British enjoyed high-quality radar fire control, allowing them to detect the fall of shot, regardless of the visibility, and correct the aim accordingly. The Type 284 set even detected incoming German shells. This leads us back to the point about analysing performance based solely on technological factors. In other conditions, *Scharnhorst* might have been able to put up more of a fight. While it is interesting to consider what might have happened if *Bismarck* had not been crippled, or *Scharnhorst* had not been taken by surprise, we can only base an empirical analysis on what happened, rather than what might have been.

AFTERMATH

By the end of 1943, the Kriegsmarine had effectively lost all four of its battleships. *Bismarck* and *Scharnhorst* had been sunk, *Gneisenau* had been damaged so badly she was no longer serviceable and *Tirpitz* had been less badly damaged, but still rendered non-operational for several months. In contrast, six of the seven British battleships described in this work were still in operation. Although the Nelson class were really no longer mechanically suitable for front-line operational duties, they could still serve in a shore bombardment role, and did so off Normandy in 1944. The four surviving King George V-class battleships were not only very much in operation, but had been rendered even more effective. This was thanks to improvements in their radar and fire control capabilities, and in the strengthening

HMS *Nelson*, pictured entering Algiers in May 1943. Like *Rodney*, she had become mechanically unreliable, and was now too slow to take on modern enemy battleships. Her powerful armament meant that she was still useful conducting naval bombardment missions.

of their light anti-aircraft firepower. Now, with the Kriegsmarine surface threat neutralized, these ships could be sent to other theatres of war.

The King George V-class ships were sent out to the Pacific, where they served with the British Pacific Fleet, or the Eastern Fleet. While it was now clear that the era of the battleship had passed, these vessels still remained useful as floating batteries for shore bombardment, firing in support of Allied amphibious landings. After 1943, it became usual to integrate a warship's main-gun fire control system with the other weaponry of the ship. The rapid development of radar technology encouraged this, as a means of better coordinating the capabilities of the ship. An Action Information Centre was introduced, where the functions of the plotting room could be combined with the systems already in place for the ship's anti-aircraft fire control. Information from a range of sensors could then be shared and coordinated, resulting in a far more efficient means of fighting the warship. In the post-war years, this would become known as the Ops Room.

As for the war years themselves, in 1941 a battleship's gunnery direction system remained the key to any surface duel with another battleship. The smooth flow of gunnery data from optical rangefinders and lookouts to the DCT and on to the gun turrets was critical. Although there were few differences between the British and German systems for this, the Kriegsmarine had a slight edge thanks to the better optics fitted to its ships, and to its own more logical method of achieving a straddle on a target. This, though, was negated by the British superiority in search radar, which meant that once a German ship was detected, it could be shadowed, and other more powerful warships vectored in to intercept the German battleship. Just as important was the Allied edge in intelligence-gathering, especially after the German Enigma codes were broken. The result was that, armed with this, the British had a much better chance of bringing a German battleship to battle on favourable terms.

The development of reliable fire control radar, though, was a real game-changer. The surface-search radar fitted to these German battleships gave them an elementary radar fire control capability, but only out to a range of around 12 miles. By contrast, from late 1941 onwards, British battleships were fitted with dedicated fire control radars, which became increasingly efficient as the war progressed. By late 1943, these could guide the fire of a battleship's main guns at double the range of the German sets, and with a much higher degree of accuracy. These could be used to augment visual gunnery direction, or could operate independently, in conditions where visual gunnery direction was impossible.

In the end, though, it all came down to the effective aiming and firing of a battleship's main guns. Here, the German battleships had the edge in terms of mechanical reliability, or rather they did, until the teething problems of the King George V class were overcome. Then, the combination of reliable guns and radar fire control meant that it was the Royal Navy who enjoyed the advantage. The raw firepower of the Nelson class might well have overcome the accuracy of fire of the Bismarck class, although the German battleships enjoyed better gunnery direction. While the Bismarcks clearly had the edge in protection over both classes of British battleship, what tipped the balance in the British favour was radar. Ultimately, it allowed the battleships of the Home Fleet to locate an enemy, dictate the tactics of an engagement and then direct their fire with deadly effect.

BIBLIOGRAPHY

Asmussen, John, *Bismarck: Pride of the German Navy*, Fonthill Media Ltd., Cirencester, 2013

Brown, David K., *Nelson to Vanguard: Warship Design and Development, 1922–1945*, Chatham Publishing, London, 2003

Campbell, John, *Naval Weapons of World War Two*, Conway Maritime Press, London, 1985

Freidman, Norman, *Naval Radar*, Harper Collins, London, 1981

——, *Naval Firepower: Battleship Guns and Gunnery in the Dreadnought Era*, Seaforth Publishing, Barnsley, 2013

Gardiner, Robert (ed.), *Conway's All the World's Fighting Ships*, Conway Maritime Press, London, 1980

——, *The Eclipse of the Big Gun: The Warship, 1906–45* (Conway's History of the Ship series), Conway Maritime Press, London, 1992

Gröner, Erich, *German Warships, 1815–1945*, vol. 1: *Major Surface Vessels*, Conway Maritime Press, London, 1983

Heathcote, Tony, *The British Admirals of the Fleet 1734–1995*, Pen & Sword, Barnsley, 2002

Hodges, Peter, *The Big Gun: Battleship Main Armament, 1860–1945*, Conway Maritime Press, London, 1981

Jacobsen, Alf R., *Scharnhorst*, Sutton Publishing, Stroud, 2003

Konstam, Angus, *The Battle of North Cape*, Pen & Sword, Barnsley, 2009

——, *Battleship Bismarck 1936–41: Owners' Workshop Manual*, Haynes Publishing, Yeovil, 2015

Mallmann Showell, Jak P., *Hitler's Navy: A Reference Guide to the Kriegsmarine 1939–45*, Seaforth Publishing, Barnsley, 2009

Martienssen, Anthony, *Hitler and his Admirals*, Dutton Publishing, New York, 1949

Von Müllenheim-Rechberg, Burkard, *Battleship Bismarck: A Survivor's Story*, Naval Institute Press, Annapolis MD, 1990

Parkes, Oscar, *British Battleships 1860–1950: A History of Design, Construction and Armament*, Seeley Service & Co., London, 1966

Roberts, John, *British Warships of the Second World War*, Seaforth Publishing, Barnsley, 2017

Roskill, Stephen W., *The War at Sea*, vols. 1 and 3 (History of the Second World War series), HM Stationery Office, London, 1954

Santarini, Marco, *Bismarck and Hood: The Battle of the Denmark Strait: A Technical Analysis for a New Perspective*, Fonthill Media, London, 2017

Skwiot, Miroslaw Z. and Prusinowska, Elzbieta T., *Hunting the Bismarck*, Crowood Press, Marlborough, 2006

Vulliez, Albert and Mordal, Jacques, *Battleship Scharnhorst*, Hutchinson, London, 1958

Whitley, M. J., *Battleships of World War Two*, Arms & Armour Press, London, 1998

Winklareth, Robert J., *The Bismarck Chase: New Light on a Famous Engagement*, Chatham Publishing, London, 1998

——, *The Battle of the Denmark Strait: A Critical Analysis of the Bismarck's Singular Triumph*, Casemate Publishing, Oxford, 2012

Zetterling, Niklas and Tamelander, Michael, *Bismarck: The Final Days of Germany's Greatest Battleship*, Casemate Publishing, Newbury, 2009

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Front cover, above: KMS *Bismarck*, firing at HMS *Hood* and HMS *Prince of Wales* on the morning of 24 May 1941. Around her can be seen shell splashes from HMS *Prince of Wales*.
Front cover, below: HMS *Duke of York* at the Battle of North Cape, 26 December 1943. Around 1700hrs, KMS *Scharnhorst* fired a series of salvos that straddled the *Duke of York*. However, *Duke of York*'s gunners held the advantage, using their fire control radar to accurately target their German opponent.

Editor's note
In most cases imperial measurements, including nautical miles (NM), knots (kts) and long tons, have been used in this book. For ease of comparison please refer to the following conversion table:

1 NM = 1.85km
1yd = 0.9m
1ft = 0.3m
1in. = 2.54cm/25.4mm
1kn = 1.85km/h
1 long ton = 1.02 metric tonnes
1lb = 0.45kg

Author's note
In 1925, a nautical mile was established at 1,853m (6,080ft). However, for the purposes of gunnery, a more practical unit was the sea mile of 2,000yds (1,828m). In this book, when referring to gunnery or radar ranges, this is the measurement being referred to.

Naval ranks

Enlisted	
Seemann	Seamen
Matrose	Ordinary Seaman
Matrosen-Gefreiter	Able Seaman
Matrosen-Obergefreiter/Hauptgefreiter	Leading Seaman
Matrosen-Stabsgefreiter/Stabsobergefreiter	Senior Leading Seaman
NCOs	
Obermaat	Chief Petty Officer
Bootsmann	Boatswain
Stabsbootsmann	Senior Boatswain
Oberbootsmann	Chief Boatswain
Stabsoberbootsmann	Senior Chief Boatswain
Officers	
Fähnrich zur See	Midshipman
Oberfähnrich zur See	Midshipman
Leutnant zur See	Lieutenant
Oberleutnant zur See	Lieutenant (junior)
Kapitänleutnant	Lieutenant (senior)
Korvettenkapitän	Lieutenant-Commander
Fregattenkapitän	Commander
Kapitän zur See	Captain
Kommodore	Commodore
Konteradmiral	Rear Admiral
Vizeadmiral	Vice Admiral
Admiral	Admiral
Generaladmiral	–
Grossadmiral	Admiral of the Fleet